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Engineering News-Record

Devoted to Civil Engineering and Contracting
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Germany's industrial dislocation is the central fact in the European situation. Its effects reach even to this country. Therefore, every reader, whether engineer or contractor, is concerned with Germany's coal problem, the crux of her industrial future. An article in this issue discusses the problem and also the socialization of mines.

To train administrators and proprietors rather than subordinates, is the central idea in the reorganization of Antioch College. The plan is that of an engineer, worked out after analysis of the place the small college should hold in our educational system. It bears all of the freshness and inspiration characteristic of a novel idea. It is of interest to all who are concerned with educational advancement.

Repairing Through-Truss Bridge on Which Train Was Wrecked

By Clyde B. Pyle

Highway Cost Analysis Simplified by Illinois Reports

By I. E. Scott

Bubonic Plague—The Engineering Problem in its Control

By Edmund B. Besselievre

KREOLITE LUG WOOD BLOCKS

GROOVED BLOCK
RECTANGULAR BLOCK
LUG BLOCK
HEX BLOCK
KREOLITE NEWS
Kreolite Building, Toledo, Ohio, December, 1920
No. 7
Vol. 7
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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

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Thrift Week

THIS is Thrift Week. Led by the Y. M. C. A. the nation's thoughts are being especially directed toward saving and, its corollary, intelligent spending. The lessons to be inculcated have a general applicability; therefore, we make no apology for referring to the subject here. In fact, engineers and contractors, as leaders and employers, have an opportunity to impress upon others the need of thrift. Possibly the idea that most needs to be hammered home is that every one *can* save. It requires planning and self-denial—and, as a rule, far more planning than self-denial. Carelessness, lack of system, are more to blame for our poverty than any other causes. Two of the Y. M. C. A.'s "Ten Financial Commandments"—make a budget and record expenditures—would, if generally applied, have so wide reaching an effect as to change, we believe, the whole economic attitude of the nation. Budget making and balancing are of the essence of good business. They more quickly give one an idea of the methods of conducting a successful business, a successful society, a successful home than any thing we know. True, they touch only the material side of life, but they are a necessary basis, without which the spiritual and sentimental sides are likely to suffer serious disturbance.

Reinforced Concrete in Sea Water

IT IS CUSTOMARY to assume that the defense against sea-water attack of reinforced concrete is a deep embedment of the steel and a good, dense concrete. The present condition of the southern California pleasure piers, noted on another page, gives at least a partial confirmation of this. That is, there is no doubt that the lightly covered steel is the source of primary failure in those structures, but whether the "good dense concrete" would save the situation is open to question. Certainly the concrete in these piers is not poor concrete; in fact, as ordinary surface inspection goes it is, as a rule, distinctly first class. Yet the corrosive salts penetrate to the steel to the ultimate failure of the structure and the behavior is so consistent that one doubts whether an inch or two more embedment would save the situation. The evidence in this case, and in that of the Boston Harbor test pieces also noted, is valuable mainly as an addition to the accumulating facts regarding sea-water concrete. There is no absolute quantitative rule yet to be laid down for such concrete, for the data are not altogether consistent, but it seems safe to say that concrete can be made that is proof against a destructive attack by sea water of the concrete itself but that it is extremely difficult to make it dense enough to protect against corrosion any steel which is near enough the surface to be of value as reinforcement. The better part of judgment would be not to use reinforced concrete of the articulated type which requires slender members in any ocean structure.

Embargoing Railroad Credit

A SERIOUS condition of railroad credit was brought out last week at hearings before the House interstate commerce committee on the bill directing the Treasury Department to make partial payments of amounts due the carriers covering the guarantee period from March to September, 1920. While it is acknowledged that at least $300,000,000 is now due the railroads the treasury has ruled that it can only make payments upon final certification by the Interstate Commerce Commission of the totals due. The commission itself favors partial payments on the basis of minimum acknowledgment of indebtedness, and several of the commissioners urge the passage of a bill authorizing and directing the treasury to make such payments. Many carriers have already found themselves unable even to meet operating exepenses, i.e., bills of supply and material manufacturers. The government owes the Pennsylvania system more than $40,000,000, and the railroad as a result cannot pay a large number of its bills covering materials for current use. Another road has over $20,000,000 withheld. The falling off of traffic and the consequent reduction of net earnings—only 3.5 per cent of the valuation, as indicated by the November figures of Class 1 roads—have increased the strain on the carriers' credit, so that not only the railroads suffer, but also their creditors and the banks that have had to assist in carrying the burden. The construction industry has a direct interest in the situation for no large sums for construction work (capital account) can become available until the credit of the roads is improved by their ability to pay accounts already overdue. The effect of the Treasury Department's ruling against making partial payments on account, however necessary from the legal viewpoint has been to embargo railroad credit. It is hoped that there will be speedy relief through early passage of the pending bill.

A. G. C. Meeting

UNTIL the war showed the necessity for a nation-wide organization of contractors there was not the whole year through a meeting of the contracting branch of the construction industry that was comparable to the place which the annual meeting of the American Society of Civil Engineers holds in the engineering branch of the field. Merely to mention the matter is sufficient to indicate that that was a deplorable condition. The Associated General Contractors are but two years old. The organization has subordinate member bodies—consisting of associations of local contractors —in some fifteen cities, one of them in Canada. It has divisions devoted to the problems of contractors specializing in building, highway, railroad and public-works construction. It is functioning vigorously. Committees are working on the standardization of practices; others are concerned with the major problems of con-

struction organizations. Obviously, the scope of such an association is broad. There are difficult problems in connection with labor, with materials, with transportation, with finance, while legislation requires close watching. All of these things are included in the vision of the organization. It should in a few years produce results in the contracting branch of the construction industry that will compare favorably with the organized work in the engineering branch. Furthermore, it affords an agency through which important co-operative work can be done. The New Orleans Convention next week should mark a further important step in its work of getting settled to its important tasks.

Emergency Service

RESISTANCE to the impact of a train wreck such as displayed by the Georges Creek bridge, whose repair is described in this issue, is not often called upon, yet its value is obvious. In fact, such resistance is expected of a bridge. Failure of a bridge under a wreck will cause engineer as well as layman to think that the structure was not quite all that it should have been. Consciously or unconsciously, we do demand of bridges that they be sturdy enough to resist abnormal attack of this kind; a fair-weather bridge is not enough for the needs of railroad service. While bridge design does not have emergency service in view, yet specifications that do not produce structures with adequate resistance to such service will fail of proper effect. It may well appear surprising that existing bridges do possess this extra strength and sturdiness, since designers do not take account of possible emergencies nor do current specifications and standards of design make allowance for them. Where does the extra resistance reside? Partly, no doubt, in the safety margin! but if this were the sole or even the most important source of robustness or "toughness" of a bridge, then equal resistance should be expected from different types of structure, which is against all practical experience. The designer's instinctive foresight and seasoned judgment are decisive factors in making a structure sturdy. In the end, however, these factors must be translated into more concrete terms and suitable principles incorporated in our standards of practice. Present specifications and standards are immature, in so far as they do not specifically assure resistance to emergency attack. Indeed, if the short paneling and the stubby proportioning of the members of the bridge in question contributed to its surviving the violent battering it received, then recent specifications tend away from a desirable type, since they give preference to designs with low secondary stress ratios and therefore discourage the use of a design such as represented by this structure. Both the requirements of emergency service and those of normal service demand consideration in fixing standards of practice, and in some instances the former may claim controlling weight.

A Reconnoissance Only

TOO LARGE a subject for a single evening made the discussion before the New York Section of the American Society of Civil Engineers on Jan. 13 no more than a reconnoissance of "Water Supply and Sanitation in the Metropolitan District, Including Sewage and the Disposal of Solid Wastes Such as Garbage, Ashes and Snow." (See p. 104.) Perhaps only a reconnoissance was intended, but if so should not the usual more detailed survey follow, especially in the fields of waste disposal?

Dr. Soper—perhaps as an exaggeration to challenge discussion—virtually accused engineers of having failed to do their duty in sewage disposal and of having left the disposal of garbage and other solid wastes a virgin field. The subsequent discussion, especially that of Messrs. Hazen, Whipple and Fetherston, went far toward clearing engineers of the charge of neglect in these fields. Certainly engineers have responded when they have been given a chance to solve any or all of the various sewage and waste disposal problems, classing each—as has also the public to a large extent—according to its vital importance and its relative claim upon limited available municipal funds. Lack of time and the minor position of garbage disposal on the program were perhaps responsible for the fact that the previously uninformed person who attended the meeting must have left the hall with no conception of the vast amount of solid engineering work that has been done in the fields of garbage incineration, reduction and hog feeding, both in the Metropolitan district and elsewhere; nor of the fact that today the garbage of nearly all the large cities and many small ones is being utilized by reduction or feeding; nor of the blundering way in which New York City has been handling garbage disposal for the past three years—because it has cut loose from common sense and good engineering and has been led nowhere by will o' the wisp inventors and promoters.

To devote an evening to sanitary problems in the Metropolitan district and not bring out such facts at a time when New York City seems ready to plunge into almost any untried method of garbage and refuse disposal shows how much too large for a single evening was the topic discussed on Jan. 13. For the present the larger questions of water supply in the Metropolitan district are either solved or else in competent hands; sewage disposal for the most part can wait, if need be; but garbage and refuse disposal, more especially in New York City, needs to be put back in the hands of engineers competent to handle it—not because of any great menace to health but as a matter of efficiency.

The Uniform Vehicle Law Conference

THE National Conference on Highway Traffic Regulations labored for three days at Washington last week and brought forth a set of "general principles." In their avoidance of specific statement they closely resemble the usual political platform planks which "commend" and "deplore" in a flood of generalities without binding canditates to any real definite performance. Too much stress, therefore, should not be placed upon the approval of the general principles of a uniform vehicle law. That action means merely that agreement could not be reached on the definite form of bill which had been prepared.

It was a good deal to expect that such diversified bodies as state highway departments, automobile organizations, police departments, electric railways, agricultural equipment associations, trailer manufacturers, insurance companies and others could, in a three-day session, unite in their approval of a specific form of law. The discussion showed that the demands of three powerful groups—the highway, the automobile and the agricultural bodies—would have to be reconciled before general indorsement could be secured.

As a matter of fact, the work proposed for the conference had, in large part, been done before. Last year a joint committee, representing state-highway and motor-vehicle organizations, drafted a uniform vehicle law, of which between 30,000 and 40,000 copies have already been distributed to state legislatures, chambers of commerce and other civic and public bodies. This joint committee practically agreed on all of the provisions except the gross weight of vehicles, including loads, and the point at which the width of tire should be measured. The uniform law which that committee prepared was designed to cover the field in a workable and practical manner and has been of considerable value as a guide for legislation.

What then was the reason for the Washington conference? While somewhat more voluminous the model law submitted at Washington is substantially a repetition of the joint committee's law. On the vital questions of weight, size, speed and license fees the conference draft added nothing new.

In the corridors one heard frequent inquiries regarding the motives of the conference and references to the danger of taking action which might be construed as an attempt to make compulsory by legislative act the use of certain patented automobile accessories. In the joint committee's proposed law arm signals only are prescribed for operators intending to turn or stop their machines. The Washington draft provided that such signals "shall be given either by the use of the hand and arm or by use of a mechanical or electrical device." This section was not reached in the discussion of the Washington measure, but an amendment was proposed providing specifically for the use of illuminated number plates on motor vehicles.

There was a well-defined feeling that the meeting was a "rump convention," an attempt by Western interests to "jump" a claim already staked out by the joint committee previously referred to. It is true that thirty national and regional organizations were represented at last week's conference, but one could not escape the impression that some of them were present chiefly to watch what the other fellow was doing, rather than to unite in an effort to produce a new uniform vehicle law. Certainly it is significant that the committee on future activities brought in a report objecting to the creation of any new organization to continue the work of the conference and recommending that the conference should adjourn without provision for future meetings. This action probably disposes of the "National Conference on Highway Traffic Regulations" once and for all—which is just what we believe should have been done with it.

The Antioch Plan

THE Antioch Plan, set forth in this issue by its originator, Arthur E. Morgan, chief engineer of the Miami Conservancy District and president also of Antioch College, is certain to attract much attention in educational circles. Not only does it undertake to train for administration and proprietorship in the small college, but it challenges the theory upon which the small college is, as a rule, conducted. To the usual liberal-arts curriculum he opposes studies with the aim of preparing for a definite place in life; to the multiudinous courses of most small colleges he opposes a few courses, all contributing to a specialized product. The plan includes engineering courses, and therefore will interest engineers. Moreover, it was proposed by an engineer after making what may be termed an engineering analysis.

Much interest has been displayed in recent years in courses in business, in administration, and in administrative engineering. The Antioch scheme differs from these in that it proposes not merely to tell its students about proper methods of management and administration, but by the content and spirit of the courses, supported by co-operative work in industries, give them the confidence and poise necessary for administration and proprietorship. The theories of the two kinds of courses are radically different.

But it is not merely in attempting to prepare for administration and proprietorship that Mr. Morgan's plan opposes the educational ideas of the day. It challenges the theory that the small college should be an epitome of the large institutions. Save for the small colleges under strong religious control, notably those under Catholic auspices, they try to pattern after the universities. Their courses run the whole gamut of liberal-arts education. In opposition to this practice Antioch proposes to specialize.

To our mind the theory underlying the specialization plea is sound, while the analogy drawn between the factory and the college stimulates the sort of analysis that throws into relief the reasons for difficulties of the small college. Further analyses of this sort would probably introduce much differentiation in the courses of the smaller institutions.

To the engineer the challenge that the Antioch plan gives to present methods of engineering education is no less interesting than the broader challenge put to the educator. Mr. Morgan's engineering courses involve a new conception of the training of the engineer. They assume that there is a demand for men who need not have the capacity to design the most intricate structures nor to conduct research work, but who have a reasonable acquaintance with the methods and theories of engineering, combined with the point of view of the administrator. To some extent this concept is found in the courses in administrative engineering at the larger technical schools, but Antioch carries its thinking to a practical conclusion—by combining theoretical and practical work in engineering and business.

Contrast to present methods of teaching engineering is further emphasized by Mr. Morgan's description of the students of the larger universities as a mass product. Certainly mass-production methods are used. The courses are designed to produce a certain finished ideal, to be turned out at the end of a four-year course, neglecting entirely what may be the proper equipment for those who will leave at the end of the first, of the second, or of the third year. Under the mass-production plan the needs only of those who are certain to be graduated can be considered.

To the term "mass product" there will, of course, be objection. That Mr. Morgan expects. In fact, the whole purpose of his article is to put the new idea before engineers and engineering teachers, to the end that the reactions may be helpful in producing at Antioch a solid contribution to American educational methods. Challenges to present theories and practices, particularly when backed by remedial proposals, always have, if discussed with open minds, a beneficial effect.

Repairing a Railway Bridge Damaged by Train Wreck

Span Shifted Longitudinally by Impact of Derailed Train and Many Members Damaged so as to Require Replacement or Straightening—Work Done Under Traffic—Distorted End Post Straightened with Jacks

By Clyde B. Pyle
Engineer, McClintic-Marshall Co., Pittsburgh

DERAILMENT of the locomotive of a loaded coal train last August resulted in serious damage to the floor system and trusses of two 150-ft. double-track through riveted spans at Georges Creek Junction, near Cumberland, Md. The train, loaded with coal, was coming east and by some unknown cause had acquired a high speed on the down grade approaching the bridge. The locomotive was derailed at a frog just beyond the bridge and the cars piled up behind it. About 35 cars lodged on the bridge, as shown by the view Fig. 1. They did most damage to the south truss and floor of the near span, leaving the north trusses so little damaged that it was considered and proved to be safe for trains to run on the westbound track after the wreckage had been removed. Subsequently the damaged parts had to be replaced or repaired, under traffic; the methods of doing this work are briefly described in the present article.

FIG. 1. LOADED STEEL COAL CARS PILED UP ON TWO 150-FOOT BRIDGE SPANS

The effect of the wreck on the floor and stringers may be judged from the view Fig. 2. The two main end hangers and one post at center were cut entirely off and the other post at center was held by only one leg of one angle. The diagonals and sub-members were badly damaged. All web members of the one truss except the upper part of the two middle diagonals were in such condition as to require replacing.

The stringers and the upper half of the floor beams were badly twisted and bent. Most of the stringers had to be renewed; a few merely had the top flange angles renewed. In all floor beams the top flanges were renewed, and in most cases also the top half of the floor-beam web, from stringer of the westbound track to the south truss, was replaced by a new web section and the necessary splice plates.

The force of the train against the floor beams was so great as to move the span longitudinally about 6 in., against the adjacent span. The brackets carrying the track outside of the end floor beams came into contact with such force as to buckle them. The bottom chord of the south truss moved about 2 in. more than the north truss of the same span, but the top lateral system, retarding the movement of the top chord, distorted the outlines of the truss. The bending of the web members further distorted the chords, thereby changing the camber of the lower chord. Near one end it was about 1 in. low and near the other end about 1 in. high. One hip was lowered and the other raised.

The distortion of the truss made replacement of members a rather complex problem. When the two new posts and new end hangers were put in place, they were connected at both top and bottom, but the diagonals were connected to the upper chord only, until the truss should be brought back to shape. The camber was made *nearly* correct by wedging the lower chord on a few bents of falsework (Fig. 3), but it was found impossible by several wedge jacks to bring it back to what it had been originally. The truss was then jacked back longitudinally about 2 in., which brought it into correct position relative to the other truss; this made the camber practically correct. The holes in each of the diagonal connections now mismatched those in the gusset plates by $\frac{1}{4}$ in., but driving about eight driftpins in each point simultaneously brought the holes to match and the truss proved to be back to its original shape.

Before this work on the diagonals, it was found in placing one of the middle posts that the chords were too close together to make the holes. Two 12 x 12-in. timbers with 60-ton hydraulic jacks were placed between the chords, and the falsework under the floor beam (this

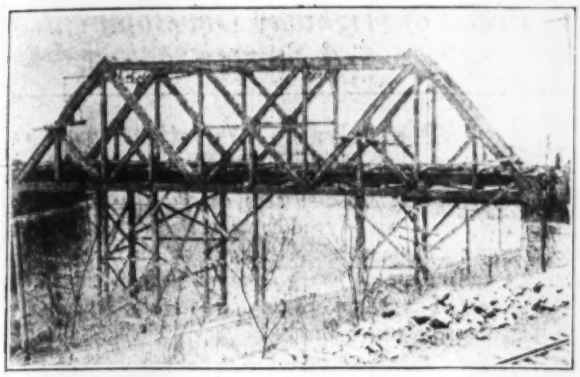


FIG. 3. REPAIR ALMOST COMPLETED; FALSEWORK IN PLACE

end of the floor beam being connected to the lower chord only) was lowered to clear the chord. With a considerable load, probably 80 tons, on both jacks, the rivet holes did not match well enough to allow pinning them. Then a locomotive was brought on the floor beam, and the holes came to match. It is rather remarkable that the floor beam with one end connected only to the chord, and with a heavy load at this end, would carry a locomotive.

It may be interesting to note that the original truss, built by the company with which the writer was connected, which also carried out the repairs, was assembled and reamed before shipment. Therefore there was some doubt as to how the new web members should be fabricated to assure enough leeway in adjusting the rivet holes in the field and yet not delay erection, as it was desired to replace each member between trains. The longest interval available, two hours, would give far too little time to place the members with small holes and to ream, pin and bolt without delaying traffic. It was therefore decided to punch the holes $\frac{13}{16}$ in. (for $\frac{7}{8}$-in. rivets) and simply run a $\frac{15}{16}$-in. reamer into them to clear away the bad metal. This plan of reaming to full size in the shop proved successful in that about 80 per cent of the holes matched the old holes almost perfectly, and none mismatched by over $\frac{1}{4}$-inch. Straightening the end batter post (Fig. 4) under traffic and without falsework was done by means of a jacking rig, shown in Fig. 5. Old 24-in. plate girders with 6 x 6 x $\frac{3}{4}$-in. flange angles, to which were fitted cover plates made from old stringer webs, were held by four 2-in. bolts and field-made channel yokes. Small screw jacks and a 60-ton hydraulic jack were used to do the straightening. Long bends came out rather easily with about a half dozen screw jacks, each of about two tons capacity. Burning out the outstanding legs of the post angle, bolting on temporary straps as in Fig. 5, and using the 60-ton jack, made it possible to take out the shorter bends readily. A heavy diaphragm was put in the center of the member, running from the lower batten plate to the upper end of the sub-hanger. After this diaphragm was well bolted and pinned, the corner angles were replaced one at a time by the new ones.

FIG. 4. BENT END POST

In cutting apart the old steel, the surfaces riveted in contact in the shop were found to be clean close to the rivet holes, but farther away about two-thirds rusted and one-third covered with shop paint or the dust resulting from burning the paint by the rivets. The rust was very slight, although the bridge has been in place about ten years. The field connections were free from rust around the rivet holes where there was perfect contact, but the balance of the surface was almost entirely covered with very slight rust; here and there was an indication of paint. This rust was very slight, and was not more than that of the mill scale. There was no evidence anywhere of continuous rusting, pitting or damage or danger of increase of rust beyond a mere film. As a matter of interest it might be stated that bridges of 30 to 35 years' service on the Southern Ry. taken out under the writer's direction showed about the same rust conditions as on this bridge. It is evidently caused by rain before the field paint is applied, and becomes no worse because the moisture is eliminated by filling the cracks and crevices with field paint. This seems to confirm the belief of some engineers that painting of field splices is unnecessary.

FIG. 2. DAMAGED FLOOR AND TRUSSES

Straightening of steel in place proved to be work of decidedly different character under different conditions. Where the bend was so slight that the steel was not actually stretched it was readily jacked straight or bent

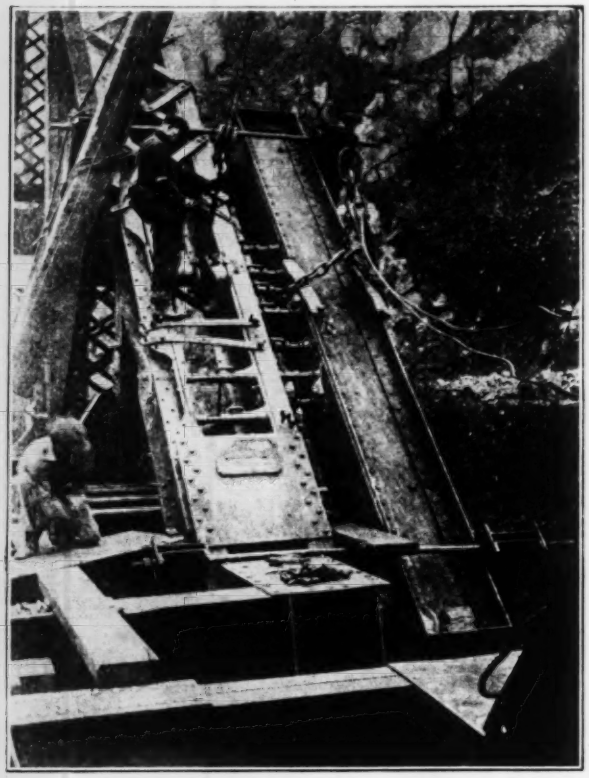


FIG. 5. STRAIGHTENING THE DAMAGED BATTER POST

by heavy mauls or a rail ram. If the steel was heavy, ¾ in. thick or over, and was bent so as to be stretched, it could not be straightened even after heating moderately with an oil torch. When the attempt was made to straighten an angle by heavy forcing, it was apt to bend as a whole in the perpendicular direction, so that it was necessary to replace everything that was bent far enough to cause perceptible stretch.

Combating Increase of Fire Hazards

Fire protection men were aroused recently by the publication of a series of articles in a popular woman's magazine on home dry cleaning, in which the use of gasoline was recommended and discussed in a way that threatened to result in greatly increased fire hazard throughout the country. To counteract the possible harmful effect of these articles, W. E. Mallalieu, president of the National Fire Protection Association, has prepared an article on the hazard of dry cleaning in the home, which is to be published shortly in the same magazine and is expected to draw general public attention to the dangers attendant on the free use and storage of gasoline in dwellings. A somewhat similar increase of the home fire hazard was threatened by the action of another periodical in offering as a premium to boys for obtaining new subscribers a home moving picture machine, which would bring nitrocellulose motion-picture films into the home without the safeguards prescribed for film theaters. Protest was made to the journal by the National Fire Protection Association, and as a result the journal has withdrawn the moving-picture machine from its premium list.

Trend of Highway Development —A Survey

Pennsylvania's Practice

THIS IS THE ELEVENTH *of a series of articles on highway practice. It discusses chiefly the policies of proceeding with paved road construction despite market prices, of creating permanent organization for highway service and of maintenance to serve year-round traffic.*

The twelfth and last article of the series will appear in next week's issue.—EDITOR.

PAVED highway construction was pushed to the limit of possible production in Pennyslvania in 1920. Prices were not permitted to curtail the mileage placed under contract if a traffic need for paved road was evident. With 681 miles of construction brought forward from 1919, contracts were let for 346 additional miles of pavement, making a total of 1,027 miles under contract. Of the mileage under contract 420 miles were completed. Both the contract mileage and the completed mileage are the greatest recorded for any state.

DEVELOPMENT POLICY

A study of highway practice in Pennsylvania indicates the following process of thinking prevailed: Need is superior to cost; if a highway is needed, go into the market and buy that highway. Need is measured in commodity units and cost must be measured by the same units. So long as paved roads cost no more in commodity units, bushels of wheat or tons of iron, in post-war than in pre-war times, their construction is warranted. With funds provided by bond issues, construction of none but highly improved roads, promising a life as great as the life of the bonds, is justified. With these fundamentals esablished, the logical policy is to plan a system, keep to that system and build as rapidly as possible. For construction, the first requirement is complete elimination of political interference with business administration. The next step is organization; build up an organization as does a great manufacturing industry or a great railway company.

Warrant for the policy followed last year, of paving the greatest mileage practicable, is found in the need for paved roads. Briefly, this need, at least for the main traffic routes of the state, was valued at more than the market price. This was a valuation which most other road-building states refused to accept. Therefore, Pennsylvania was virtually alone in 1920 in freely undertaking contracts for highways of the first class. Attack or defense of this policy is not in order at this time, but the policy has to be noted as one of the facts which stand out in the trend of highway development.

CONSTRUCTION AIDS

A policy of service to the contractor accounted in large measure for the volume of work done. This service was rendered first through the testing laboratory, which prospected local sources of materials and advised the contractor on their utilization. A service of more immediate value, however, was in securing transportation. Both aids were developed to a higher degree of perfection than is customary.

Materials investigations, although only one of the duties of the testing laboratory, are conducted with the

most careful attention to their practical usefulness. Locations and extent of deposits and their suitability for road construction are determined closely, but the survey goes farther and determines all the local conditions which affect pit or quarry development and transportation of the product. Neither the quantity nor the continuance of quality is guaranteed and the contractor is expected to determine himself all facts affecting development, equipment and transportation, but the records of the laboratory investigations are open to him as are the opinion and advice of the laboratory engineers.

Transportation of construction materials for highways was last year about 75 per cent efficient; about three-quarters of the required service was provided. Two circumstances aided in this accomplishment. One is that practically all of the road materials can be provided by intrastate hauls. The other is that about 50 per cent of the service required can be provided by a single railway company, which has adopted the broad policy of actively assisting highway improvement. All traffic, nearly, being intrastate, car orders for road materials were secured through the Public Service Commission as described in *Engineering News-Record*, Sept. 23, 1920, p. 612.

Organization Highly Developed

Co-ordination of transportation service with the requirements of many scattered construction operations was effected by the traffic officials of the highway department. This was quite as important a factor in the success of the service rendered as were car orders and the disposition of the railways to help. It was made possible by that thoroughness of organization which characterizes the Pennsylvania highway department.

Particulars of the organization of the department cannot be given here. It has been built up on the assumption that highway service is a continuing business of great size which will increase in magnitude. With this conception, complete organization machinery is essential; administrations may change and policies may alter, but a working organization is basic. Policy, finance, research, design, construction and maintenance in all their phases are provided for in the organization now operating.

This organization operates on the theory that all information is open to reasonable inquiry. Its records are kept in unusual detail and also in a form which permits essential facts to be visualized and appraised quickly. For the latter purpose graphs have been developed to present all the main facts. They have proved of signal service in the internal activities and in presenting facts to the public.

Maintenance is considered even superior to construction in importance. Its purpose is to keep the highway structure as nearly as possible in its original perfection, and in usable condition the year around. The fact that snow removal has been carried farther than elsewhere is an illustration of the latter purpose. A year's records of maintenance operations show 315 miles resurfaced, 1,400 miles treated with bituminous surfacing, 4,000 miles of surfaces kept in repair and 6,175 miles of earth roads maintained. This program involved an expenditure of $7,000,000 and an average organization of 4,000 men.

Preparedness, system and the development of machine methods are considered the essentials of successful maintenance. Materials for the succeeding season's work are delivered on the highways in fall and winter. When materials are shipped in quantities to justify it, unloading plants are installed at the sidings. Motor trucks have replaced teams for hauling. Large crews for spreading covering materials in bituminous-treatment operations have been eliminated by the adoption of mechanical spreaders hauled by small tractors and trucks, which can also be used for hauling. In earth-road maintenance fleets of tractors operate the road graders. A material reduction in the number of men required for maintenance has resulted from these methods.

Snow removal is considered an established maintenance duty. Both removal proper and means for preventing drift formation are employed. The task is one of careful organization and detailed methods and will be described in a future issue of *Engineering News-Record.*

Research and Design

Only permanent construction is considered justified on main traffic routes. Permanency of subgrade is fundamental. In the paved road work of 1920, over 45 per cent of the money was expended in producing permanent grade. In subgrade design attention is given particularly to drainage, soil capillarity, compactability of soil and soil treatment to reduce moisture effects. Designs are changed from point to point on each road, as conditions require. As an example, the standards of the department indicate half a score of drainage ditch plans for regular use as the conditions may indicate.

To assist in perfecting design the testing laboratory is making a study of cores taken from all kinds of pavement in service. Where these cores were removed the pavement is kept open for a study of subgrade moisture conditions. Service studies are given preference in all research work.

In a word Pennsylvania's practice in 1920 is based on the following assumptions or principles: (1) The need of improved roads is superior to questions of cost; (2) organization is a supreme necessity in highway improvement; (3) maintenance is secondary to no other highway activity.

Methods of Eradicating Moss from Canals

Seven ways of combatting moss and plant growth in canal systems are given in the November *Reclamation Record* (Washington, D. C.) by George E. Stratton, project manager, Milk River Project, U. S. Reclamation Service. He queried several project managers on the subject and gives his own experience. Muddy water seems to be of doubtful value. Hand methods work on a southern project. Drying out the canal and letting the sun kill the growth works when there is time. Submarine saws are successful in some places but not in others where the moss is not stiff enough to be cut. Dragging with a spring-tooth harrow is effective but disturbs a soft canal bottom. Dragging a chain is the most practical method used by Mr. Stratton. About 33 miles of canal were dragged with a chain made of 1¼-in. reinforcing bars with 18-in. links. The cost was $9 per mile. A special harrow with knives set at an angle used on one project was abandoned for submarine saws. Copper sulphate has proved successful on concrete-lined canals. It does not work so well in earth canals.

Water Supply and Sanitation in the Metropolitan District of New York and New Jersey

Discussion Before the New York Section of the American Society of Civil Engineers Deals with Water Supply, Sewerage, Refuse Disposal and Snow Removal

CONTINUING its monthly discussions of engineering problems that confront New York City and its nearby neighbors, the local section of the American Society of Civil Engineers had for its topic "Water Supply and Sanitation in the Metropolitan District, Including Sewage and the Disposal of Solid Wastes, Such as Garbage, Ashes and Snow." President W. J. Wilgus outlined the program and introduced the speakers. The opening address by George A. Soper and those portions of the other addresses that dealt with sewage, refuse and the snow problem are abstracted below. The discussion on water-supply will be summarized in a later issue. —EDITOR.

Opening Address

BY GEORGE A. SOPER
Consulting Engineer, New York City

TO INSURE a sanitary environment is the paramount problem which faces New York and its vicinity today. We have now a population of about 10,000,000 people in a confused mass of cities, towns, villages, boroughs, counties and states. There should be some system of co-ordinated government over the great metropolitan population. There should be definite systems of water supply and sanitation devised and administered without the embarrassments which now result from the hundred separate political parts into which this territory is divided. From some standpoints it would be an advantage if the district were to be separated from the states of New York and New Jersey in which they are now located and consolidated into a separate state—perhaps a free port.

Although water supplies may properly be considered under the head of sanitation, I submit that the problem of how we shall get rid of our wastes is a much more pressing problem at the present time than how we have procured our water. The waste problem is completely unprovided for, while the water supply as it exists today represents a high stage of technical perfection. We have scores of engineers in New York whose professional careers have been almost exclusively devoted to our water supplies and they could talk about what has been done through many long and interesting evenings. But there is hardly one in this great metropolis who has ever been called upon to devise a system for the collection and disposal of refuse and it is toward the satisfactory disposal of our wastes that I think our attention should be chiefly directed. What I have to say, therefore, is largely on the sanitary side of the title, confidently expecting that others will sufficiently speak about the water.

A strange apathy seems to possess the public with respect to the conditions under which our sewage and solid wastes are disposed of. We have become indifferent to our dirt.

SANITATION: MAKING A PLACE HEALTHFUL

The usual definition of the word "sanitation" is the science and art of making a place healthful. In its broad sense it includes the elimination of unwholesome swamps and other natural conditions which favor disease. In order to confine this evening's discussion to a practical basis, I am using the word sanitation as though it applied only to the removal and disposal of the waste products of our municipal inhabitants.

There is no question but that New York must look forward to the expenditure of large sums of money upon its sewers as well as upon the disposal of its sewage. Common prudence as well as economy demand that provision be made without further delay for this work. What is needed cannot all be done at once. The city should adopt a program of work based upon carefully prepared plans. All reconstruction should conform to these plans.

It was officially estimated that in the year 1910 the population of the Metropolitan District emptied into the Harlem each year the equivalent of 12,000,000 tons of sewage sludge, having a bulk of 14,000,000 cu. yd. It goes without saying that the amount of this polluting material is increasing rapidly. The volume of sewage being discharged into the lower East River was 246,000,000 gal. a day in 1910 and it was estimated that by 1940 it would be 454,000,000 gal. The Harlem River was receiving 99,000,000 gal. a day in 1910, and for 1940 would receive 253,000,000 gal. These two arms of the harbor, called rivers, but neither of them rivers but tidal straits, with about as much water flowing in one direction as the other, have been found to be the most seriously polluted of all the water highways in the Metropolis, and—a point of considerable significance—they are at the centre of our population. It is impossible to sanitate them on the easy principle of mere removal, for if the sewage were to be dumped somewhere else this would only shift the nuisance from one point to another. Already there has been too much of this shifting.

Realizing that the question of sewage disposal in the Metropolitan District needed careful study, the State and City of New York provided for a commission of engineers to thoroughly overhaul this subject. That was nearly fifteen years ago. It was hoped that New Jersey would appoint a similar body and that the two would work out the common problem of properly protecting the harbor in a spirit of neighborly good-will. New Jersey did not appoint a commission; New York went ahead alone.

The Metropolitan Sewerage Commission was composed of four engineers, all Members of the American Society of Civil Engineers, and one physician. It existed in efficient form for six years. Three large reports were published: the first set forth the insanitary conditions which the commission discovered to exist; the second proposed a standard of reasonable cleanness for the Harbor waters; the third provided general plans for the work which it would be necessary to construct in order to attain the standard.

WHAT NEW YORK SHOULD DO WITH ITS SEWAGE

Briefly, the City ought to construct main drainage works consisting essentially of intercepting sewers, to gather the sewage from the present outfalls and carry it to suitable points for disposal. For the most part, the disposal work would consist of mechanically operated screens and settling basins. From these the clarified effluent would be discharged into the Harbor through long outfalls placed at the bottom of the deepest and most swiftly flowing channel.

Having acomplished what it was created to do, the Commission went out of existence. All interest in the subject seems to have expired with it. The City did not adopt the recommendation to start the work at once. New York is not improving its sewerage or sewage conditions to any considerable extent, but it at least knows what it ought to do.

Turning to the third and last division of our subject, we must take up the second class of wastes to which I referred some time ago and sketch the way in which this question is handled. It is not an agreeable task, for there is little that is commendatory about it. It is the crudest and least developed of all our great sanitary undertakings. It has never been erected to the dignity of an engineering enterprise, but has been likened to a contracting business. Certainly contracts play an important part in the disposal of the material.

Ocean dumping [the means of disposal for the bulk of the

garbage of New York since the present city administration caused the shut down of the new Staten Island reduction works—EDITOR] cannot properly be called final disposition. When the garbage of New York is dumped even as far as fifteen miles outside of the farthest limits of the harbor, it produces a nuisance along more than seventy-five miles of the New York and New Jersey shore-lines. The City has some incineration plants which burn small quantities of the wastes which are produced locally.

From the report of the Department of Street Cleaning, for the last year for which a report has been printed, it appears that the aggregate quantity of materials collected in 1918 were: ashes, 5,314,315 cu.yd.; garbage, 664,432 cu. yd.; rubbish, 3,089,395 cu. yd.; or 9,068,142 cu. yd. in all. About one-sixth of this is collected by private carts hired at the expense of those who produced the waste. The largest item was ashes, the removal of which from buildings other than private residences is not compulsory upon the city.

GARBAGE, ASHES AND REFUSE OF OVER 6,000,000 PEOPLE

The collection and disposal of solid wastes in New York is the function of the Street Cleaning Department so far as the Boroughs of Manhattan, Brooklyn and the Bronx are concerned. In Queens and Richmond this work is done under the borough president. In 1918 the department exercised jurisdiction over the solid wastes of a resident population of 5,377,456 persons and of about one million transient inhabitants.

The expenditures of the department are largely for labor. In the year 1918, $6,460,168, or about two-thirds of the total cost of the department, was for services. In 1919 the department spent, roundly, $13,000,000. This was about 5 per cent of the total cost of the city government, and nearly two dollars apiece for all the inhabitants of the city. Only two departments cost more—Education, and Police. If we add to the costs just given the cost of private scavenging, the expense incurred in removing steam ashes, and trade wastes, and consider the cost of removal and disposal so far as these are accomplished in the rest of the Metropolitan District, the total will amount to a surprisingly large figure. It is probably no exaggeration to say that the inhabitants of the Metropolitan District spend nearly $20,000,000 a year to get rid of their wastes, without getting any return or having their wastes properly disposed of.

The removal of snow from the streets is done under the supervision of the Street Cleaning Department. It is unsatisfactory from every standpoint, not least from the standpoint of the department itself. The crux of the difficulty lies in the uncertainty and infrequency of the snowfall. It appears to be impracticable to make suitable provision for the work beforehand. A great force of laborers must be assembled at short notice and the handling of these men with the supervisory staff which is available involves problems of administration which would be exceedingly difficult to cope with under any imaginable circumstances.

The snow is removed from the most important thoroughfares. It is shoveled into piles and then into carts and wagons, and hauled to the waterfront or to some convenient sewer for disposal. Often it becomes necessary to break up the compact and frozen masses of ice and snow with pickaxes. Plows have been used successfully to open ways for traffic when the snow is soft. Snow-melting machines have been repeatedly experimented with without success. Flushing the snowy streets with water has been found useful under some circumstances.

A FIELD AWAITING DEVELOPMENT

There is a general feeling that the removal of solid waste costs too much. The apparatus is obviously crude and the work inefficient, speaking generally and without particular reference to New York or any other municipality. The undertaking is generally lacking in spirit and in the interest which attaches to successful enterprises where large numbers of men are involved. In the opinion of some, there is lack of system, of method, of purpose. It has been claimed that too much dependence has been placed upon hand labor, and that there is not enough plant and equipment of a high grade of efficiency.

The subject of solid wastes is full of possibilities for development. So far as the technical side is concerned, the inventor has a virgin field, if the metaphor may be pardoned, in this connection. The practical statistician could hardly wish a better opportuunity for the exercise of his ingenuity, in showing how economies can be introduced. The expert administrator has an opportunity to show how the work can be systematized in greater loyalty, and skill stimulated.

But there is a less promising side. A natural repugnance unquestionably attaches to the whole subject of waste disposal. Looking into the future, it is impossible to see how any great improvement can be made in the work of removing the solid and liquid wastes of our houses and streets, and disposing of them properly, so long as the public views the subject with the aversion with which it is commonly regarded.

The whole subject of collecting and disposing of our solid refuse needs to be taken carefully into consideration. A commission of qualified engineers should be appointed, with a view to ascertaining the details of the problem to be solved and laying down the fundamentals of the correct solution. It would be easy to make a list of topics to which this commission could give attention. If possible, the commission should include the whole of the Metropolitan District in its scope. The results would be of value to the whole country.

The object should be not to find what is wrong, but what is right, to make what is good, better, and to prepare a plan and program of development which will put this city and this district upon a basis of enterprise and efficiency with respect to sanitation, such as already exists in regard to its water supply. When this is done, and not until then, can we call ourselves sanitary.

Other Discussions

GEORGE C. WHIPPLE
Professor of Sanitary Engineering, Harvard University

IT MAY be that the New York metropolitan district will some day have the twenty or thirty million people which Dr. Soper suggests, but I cannot help feeling that the years are not far distant when its rate of growth will materially decline and when declining growth will make the financial problem one which will overtop all others—that of sanitation included. With this future in mind as more than a possibility I believe that whatever is done toward improving present sanitary conditions and preventing future ills must keep the cost of such projects well to the front. But parsimony is not economy and preparedness is as necessary in sanitation as in war.

A stream being gradually polluted loses its dissolved oxygen little by little until it is almost gone. Suddenly the oxygen disappears and almost overnight the stream changes to a black liquid reeking with foul gases. This has happened in the past in Gowanus Canal, Newtown Creek, and the Passaic River. It will happen in the Harlem River if the pollution continues to increase and no relief is given. Will it happen in the East River and the North River? Probably not, or at least not for a great many years, except perhaps locally in spots.

The supply of oxygen brought into the harbor from the ocean is enormous. The oxygen absorbed by the water from the air is very great, and the law of absorption is that the greater the depletion the more rapid the absorption. Analyses and studies which I have personally made have convinced me that the absorption of air by the water is much greater than has been often estimated. Nevertheless, it is possible for pollution to so press upon available oxygen as to cause the critical limit to be passed. It is therefore a matter of fundamental importance that the city keep account of the natural oxygen resources of its harbor water by systematic analyses made at many places, at different depths and at all seasons, so that future conditions can be predicted with enough certainty to anticipate needed engineering works. The Metropolitan Sewerage Commission made a beginning of such a study and some work has been

done ever since. It is important that this be established on a sound and permanent basis.

In spite of all that may be said as to local nuisances around the rivers and harbors, and they already exist; in spite of the occasional oily films on the harbor water which are derived from industrial works more than from the sewers; in spite of windrows of debris from shore and shipping; in spite of a certain dullness of the water due in part to sewage but even more to the silt with the Hudson River contributes, the fact remains that New York and her neighbors on the water front are very favorably situated with reference to sewage disposal. There is not at present a serious pollution problem in the harbor. What the inland cities and towns suffer may be seen from Newark. It would be a fine thing to take all of the New York district's sewage far to sea, but it would be unwarrantably expensive. Some day, and perhaps at no distant future, some of the sewage ought to be taken out to sea; but how much, and how far, and where, and at what cost are questions to which answers have been attempted but to which no satisfactory and convincing answer has been given.

In solving the coming problems of sewage and industrial waste disposal in and around New York there will be some regions where treatment of some sort prior to removal may be necessary. It would be wise, therefore, for the city to maintain a permanent experiment station for the study of these problems. But so far as the treatment of the bulk of New York's sewage is concerned, I cannot refrain from quoting what the late Frederick P. Stearns once said to me, "If you are going to dump sewage at sea, the less you do to it the better!"

I believe that New York should continue to take advantage of the natural receptive conditions which the ocean and the harbors provide in the interest of much needed economy, but that she should closely watch these conditions and make sure that relief sewers and such other works as may be necessary are actually ready for use by the time they are needed.

I agree with Dr. Soper that the disposal of solid refuse is more difficult than that of sewage. My investigation of the Staten Island garbage project convinced me also that engineers have not given the subject the careful attention which they have paid to sewage disposal.

The treatment of garbage and the recovery of byproducts have unfortunately been chiefly in the hands of private interests who, if published statements are to be believed, have pocketed their profits, bragged of their losses, and kept their accumulated knowledge of the subject to themselves. The result is that scientific knowledge as to what garbage can be made to yield in the way of byproducts is not as great as it will have to be before the problem of ultimate disposal is solved. It is essentially a problem for the combined thought of the chemist and the mechanical engineer. I agree with Dr. Soper that a really serious experimental study of the problem of refuse disposal should be made. In these days when plague has been brought by rats and fleas to our American cities the garbage problem looms larger as a health measure than it did a few years ago. Until an adequate study has been made our city governments will flounder as they have in the past and continue to hand over the problem to companies which, very naturally, will put profit making above public service.

It has been my fortune recently to travel in the Orient, and one cannot observe the dense populations there, the reduced natural resources of the land, the lack of animals, and the universal use of human excrement as a fertilizer without reflecting on the awful waste of nitrogen which is taking place in the cities of our Western civilization, and without wondering what may be the food conditions in America a number of centuries from now. It is not a pressing problem, that of utilization of nitrogen and fats in sewage and garbage, but it is one which should be kept in mind. We throw sewage with its nitrogen and fats into the sea because at the present time it would cost more to recover these substances than they are worth in the market. That may be economically sound, but, nevertheless, it is a waste which some day must be corrected. In designing disposal works for New York, this ultimate salvage problem should be kept in mind. To throw garbage into the sea, when we do know how to recover valuable byproducts, is a sanitary crime. Some better solution should be found.

In the consideration of the sanitary needs of the communities in the New York Metropolitan District there are three mutually dependent variables which always have to be considered—size, comfort, and cost. In small communities comfort, which implies health and agreeable conditions of life, can usually be procured at a reasonable cost. In large cities comfort can also be procured, but only at increasing cost. The question for the New York Metropolitan District to solve is this: Can comfort be secured at a cost which the people can afford to pay? If the limit is approached, will it mean abandonment of comfort in order to maintain solvency, will it mean repudiation of debts, or will it mean limitation of growth? If the modern city cannot stand the economic strain, it will fall. Ex-Mayor McClellan [New York City] once pointed out that when the tax-rate reaches the normal interest rate, the taxes become confiscatory.

In the consideration of all these problems the financial element must of necessity control. Relative values must be studied and then, with fixed appropriations determined by economic considerations, a dollar must be made to buy just as much health and comfort and beauty as possible.

ALLEN HAZEN
Consulting Engineer, New York City

THE sewage problem of the New York Metropolitan District has not been overlooked by engineers. For instance, both the problem and its solution was admirably outlined by Dr. Soper's commission. It should be remembered, that from the viewpoint of sewage disposal New York City is one of the most advantageously located cities in the world, being surrounded by large bodies of moving water which in themselves and by their power of surface absorption from the air have immense oxidizing powers—powers which increase with the growth of pollution. There are points of excessive pollution, notably along the East and the Harlem rivers; but the population in the lower East River section is decreasing. The pollution studies being carried on by Kenneth Allen should be continued so as to learn what to provide for in the future. Summing up, the fact is that neither the good people in general or the good engineers of New York are convinced that the time has arrived for radical action on New York's sewage disposal problem.

J. T. FETHERSTON
Formerly Commissioner of Street Cleaning, New York City

FROM a population of 10,000,000 in the Metropolitan District about 17,000,000 cu.yd. of refuse (ashes, garbage, rubbish, street sweepings) is produced annually. On a peak day in winter 80,000 cu.yd. of refuse will be removed and disposed of by various methods. That this work is being accomplished daily without undue public turmoil means that a systematic procedure is in force, even if the methods employed do not conform to the highest standards of sanitation and economy. There is no doubt that a great opportunity exists for improvements in handling the solid wastes within the Metropolitan area. To minimize dust, litter, odor and nuisances attending the handling of the refuse is as important as to reclaim the $10,000,000 market value of the waste materials. Here, certainly, is a great problem which will test the serviceability of engineers, chemists, organizers, managers, business men and politicians.

Engineering commissions have studied and recommended methods for treating the solid wastes from the three big boroughs of the city. Colonel Waring, over twenty-five years ago, inaugurated the methods in use today. Messrs. Parsons, Hering and Whinery [with Dr. Soper providing a survey and report] in 1908 advocated the same general methods. In 1912 a committee of the Board of Estimate and Apportionment (Messrs. Mitchell, McAneny, Cromwell) after investigation approved the same general plans. And

today another committee, appointed by the present mayor, is studying the same old problem and cannot logically fail to approve the general program of Waring without disastrous consequences.

The real need today is for funds, and for administrative action, followed by competent engineering design, execution, and expert municipal operation of a complete utilization-disposal system.

Of the factors affecting the removal of snow in New York the time, depth, density and rate of fall are unknown in advance. The area to be cleared is the only known factor—30,000,000 sq.yd. of pavement, equivalent to 950 miles of roadway 60 ft. wide extending from New York to Chicago.

United States Weather Bureau Records show that for the average winter four snow storms, averaging 6 in. in depth, require removal. The Department of Street Cleaning has been organized to the last detail of the force and equipment available for handling a snowfall of 10 in. with snow of average density (12 lb. per cubic foot). A detailed study of the organization, methods, procedure and appliances used by the Department on snow work will convince any unprejudiced observer that relatively few practical improvements can be made in the set up.

The average snowfall of the winters 1914-1917 was 43 in., compared with 32 in. for the 46-yr. period 1868-1914. Between 1914 and 1917 improved methods of starting work with the storm, using motor-driven plows and up to 30,000 laborers pushing snow into sewers or piling it kept the roadways open and resulted in quadrupling the rate of snow removal while decreasing the unit cost 65 per cent compared with the three previous winters.

Recently, due to the shock received by the city officials from the storm of last winter, about $4,000,000 has been appropriated for the purchase of additional apparatus for the removal and disposal of snow.

Experts are not popular in official circles today in this municipality. Colonel Waring said: "I did the work for its own sake alone, and any competent executive can succeed if he follows this same principle."

How a Port Terminal Looks from the Air

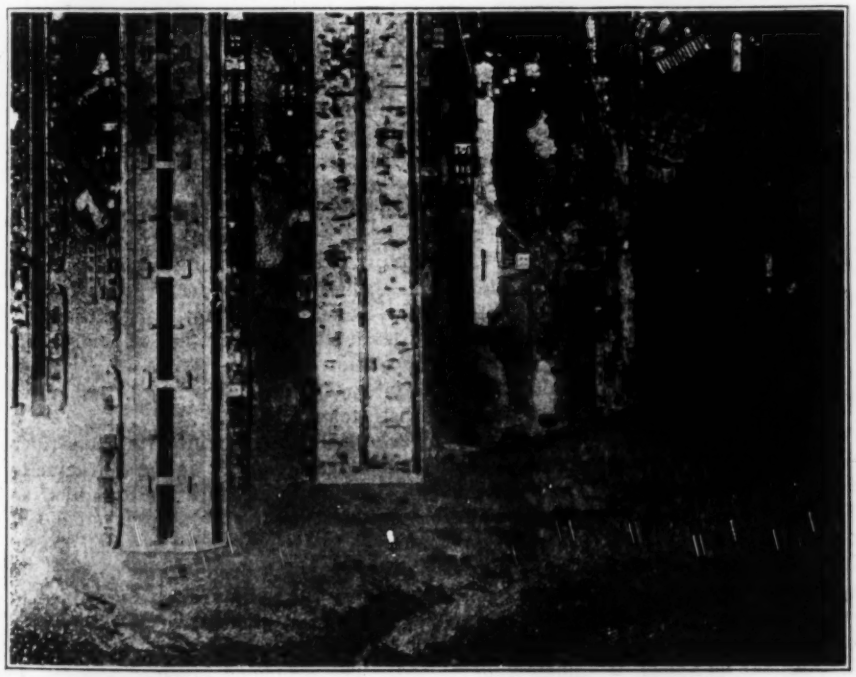
The accompanying view was taken by an army aviator flying 4,000 ft. above the completed Army Base on the Delaware at Philadelphia, Pa. It gives a remarkably good map-like impression of a modern port terminal.

Pier B, with its two 1,500-ft. warehouses is the longest pier. Its central track court has capacity for two 40-car trains and is seen to be nearly full. The two vessels at the outer end of this pier are 8,000-ton German freighters now flying the British flag; the large vessel at the inshore end of Pier B is a Dutch freighter. The 35-ft. deep slips between piers are 250 ft. wide. Fifteen ocean-going vessels can be counted docked at the base.

The half pier at left of Pier B is Pier A, has three lines of railroad track, seen mostly full of freight cars, and is a specially designed ordnance pier intended for the loading of heavy ordnance pieces directly from cars into the holds of vessels alongside. The large open-deck pier at the right of Pier B is Pier C. It is 1,320 ft. long and has foundations designed for warehouse superstructures similar to those on Pier B, but omitted after the armistice. Its four railroad tracks with freight trains are visible.

The extremely long narrow steamship at the inshore end of Pier C is the U. S. transport "Meade" now in the Shipping Board recruiting service. The piers under construction at the far right are new Philadelphia municipal piers.

The Philadelphia Army Base was described in *Engineering News-Record*, Mar. 18, 1920, p. 554. It was built by the Construction Division of the Army, under the direction of Day & Zimmerman, Inc., as supervising engineers, by the Snare & Triest Co. as contractors.



THE PHILADELPHIA ARMY BASE FROM 4,000 FT. UP

Concrete Barges on New York Canals

In his annual report on the Inland Waterways Service General F. T. Hines devotes a paragraph to the concrete barges which were built for the New York State Canals. He says that experience with them has shown that they require but a fraction of the steel needed for steel barges, and that under favorable circumstances they can be put into water within four or five weeks. Further than this, however, they are of but limited value from an operating point of view. While the maintenance costs of the concrete barges on the New York Canal are lower than the maintenance costs of steel barges, this advantage is more than offset by their greater susceptibility to damage from collision. These barges have an excessive yawing depth, even when light, 2 ft. more than steel barges. They are unwieldly to handle, navigate badly and have a tendency for yawing toward shore with the tides and endanger the tow formation. On the whole the experience of the government with concrete barges has indicated that under normal conditions they are not superior to steel.

The Antioch Plan

Training for Administration and Proprietorship at a Small College

Liberal-Arts and Technical Courses Both to Be Given Under Co-operative Plan—Campus Industries a Feature

By Arthur E. Morgan

President, Antioch College; Chief Engineer Miami Conservancy District

WHILE a discussion of the reorganization of a small college may seem unusual in an engineering periodical, the plan now being worked out at Antioch College (at Yellow Springs, Ohio) should be of interest to engineers. The plan is that of an engineer who has interested other engineers in the work. Moreover, the scheme differs so radically from current practice as to justify its being considered by all who are interested in our educational system.

This article will be justified if enough interest is aroused to bring out criticism of the scheme as a whole or in part. In fact, the author hopes that he will secure the criticism and help of engineers and this, the first published presentation of the idea, is offered in the hope that there may be directed toward it the earnest thinking of the members of the engineering profession.

The Antioch Idea

The Antioch idea, essentially, is this—

(1) To train men and women to be the persons in final responsibility, to be directors and administrators of business, professional, educational and other enterprises. Antioch will train primarily for proprietorship and management, not for subordinate employment.

(2) The essential idea can be worked out effectively only by combining theory and practice in the instruction. Therefore, the co-operative method—part time in college, part time at work—will be employed. This will also permit those to get an education to whom it might otherwise be denied.

(3) To furnish remunerative work to students and also a laboratory, on operating scale, for administrative training, campus industries are to be developed.

These are the main features which differentiate the Antioch plan from those of other small liberal-arts colleges—for Antioch will continue essentially to be a liberal-arts college, though a limited number of technical courses will be offered. Other aims and ideas there are, of course, such as proper emphasis on moral and physical training, but these do not require especial emphasis here. The object rather is to direct attention at the novel features of the plan, and secure helpful criticism thereof.

The Place of the Small College

The small college has had a very important part in the educational history of America, furnishing to many men of unusual ability opportunities that otherwise could not have been obtained. The intimate contact between student and instructor, and also between the students themselves, has resulted in better reactions than can usually be obtained at universities. For these reasons the well organized small college undoubtedly has a place in our educational system.

Antioch was organized in 1853. As far as known it was the first non-sectarian, privately endowed college in the country. It was also the first completely co-educational college, this principle being carried to the point of admitting women to positions on the first faculty. The alumnus has every reason to be proud of its record, for its influence has been much greater than its size would imply. Horace Mann, whose contribution to American education need not be discussed here, was its first president and organized the college. President Hill of Harvard, President Orton of Ohio State University, and President G. Stanley Hall of Clark came from Antioch. Recently, Dr. S. D. Fess was elected to Congress while president of the college.

For some time the governing board has been considering the difficulties of the American college, and it has been increasingly evident that unless the problem could be faced in a new way the college could not live up to the great hope of its founders—that it should be a pathfinder in higher education. Those interested called in friends outside the immediate college circle, among them the writer, who was elected to the board of trustees and, after working out the plan outlined below, was elected president of the college in order to carry the plan through. He will continue his active engineering practice, his engineering force being closely associated with the college.

Resemblance of College to Factory

An educational institution has certain points of resemblance to a factory. The academic type of educator may object to this comparison, but it is submitted that a study of the points of similarity might profitably be made by many colleges. Both the factory and the college should have a certain product in mind; those in charge should have a definite idea whether this product has intrinsic value and also, since all life has an economic basis, whether there is a demand for it. Both must select their raw materials, and their success in doing so will have a marked effect upon the product. Both must have a well-organized system for converting the raw materials into the product in mind.

The small college, like the small factory, must select an output that the larger institutions either have neglected or cannot deal with efficiently, and should fortify its position by selection of its materials in a manner which the wholesale methods of its large competitors have made impracticable.

Each type of school should recognize its limitations. Violins can be made most cheaply in large factories, but only the small shop could produce the Stradivarius. The remarkable production of leadership in small colleges is an analogy. In the case of the small college there is a possibility (1) of a product the demand for which cannot be met by the standardized mass production of the great university, and (2) of selecting on a small scale from a source of raw material not yet adequately developed. The problems involved are (a) to define the product desired, (b) to develop the necessary

processes and standards of production, and (c) to obtain the equipment.

The particular product aimed at in the vocational and technical courses at Antioch College is men and women with the capacity to stand on their feet, to be the persons in final responsibility, who direct their own courses, rather than having them directed by superiors. A fine product of this type can be secured only if the raw material—the incoming student body—is selected with unusual care, and in accordance with a definite and carefully considered policy.

It should be clearly understood that the difference between the man who is a proprietor or administrator, and the man who works under direction at a specialized job, is not wholly of size, but also of type. An extreme case may illustrate. The village blacksmith may have but one helper, but nevertheless he is a proprietor. On his own judgment rests the final decision as to the wisdom of any policy or course of action. He is final authority on metal working, purchasing, selling, accounting, shop management, in short, on every policy of his little establishment; and, with a given natural ability, his success will be greater or less depending on whether he is a master of the technic of proprietorship. On the other hand, a certain research engineer in the employment of a great corporation is said to receive a salary of more than $50,000 a year. He is of much higher grade than the village blacksmith, but his preparation need not cover nearly so wide a field.

On first impression we think of the proprietor and the administrator as belonging to a small class of exceptional men who are born and not made. However, when we consider the heads of manufacturing industries, large and small, the proprietors of commercial establishments, professional men and women in private practice, our millions of farmers, most of whom are responsible proprietors, and administrators of their small industries, and, lastly, our many women who are in fact and in daily practice proprietors and administrative heads of homes, while the specialized husband is away earning a living, we see that proprietorship is one of our chief occupations.

But, with very few exceptions, our schools and colleges do not prepare for this calling. They train men and women to obey orders, to follow instructions, to work under supervision, and to rely on the judgment of superiors for ultimate responsibility and for the determination of policy.

The central core of all vocational and technical training at Antioch is to be the *preparation for carrying the ultimate responsibility — training for proprietorship.* There exists in the United States a highly developed and enormously valuable technic of administration. This technic includes the ability and habit of analysis of a job into the factors that count for its success, such as cost analysis, plant operation, financial management, personnel organization, buying, salesmanship, development of morale, production methods, and analysis of supply and demand; while underlying all is the habit and ability of exercising responsibility and of being the final authority on matters of policy. This technic in its modern, highly developed form is the possession of very few men and women. It is the business of vocational courses at Antioch to be the medium for transmitting this technic to a selected group of students.

Where schools have endeavored to do this job there have been two chief sources of disappointment; first, failure to realize that careful selection must be made of the raw material in the form of the student body and, second, in ignoring a main part of the educational process. There are two main elements in education—first, the acquiring of knowledge through study and instruction; and, second, the development of the powers of mind and personality by practice at the occupations of life. This second element, generally omitted from the educational process, is to take an important place at Antioch. The student body will spend half time at the usual college work, and half time in industry.

The chief difference between part-time work at Antioch and that in other co-operative schools is that so far as possible the work at Antioch will center around training for proprietorship and administration. To this end it is planned to build a factory building on the campus, and to locate there a number of small industries. An inventory is now under way of small industries throughout the country in an endeavor to secure a number that will combine earning capacity, educational value and relative freedom from fluctuation due to economic conditions. By work in these campus industries and by co-operation with industries in the surrounding cities it is aimed to combine a considerable degree of self-support with training in the various phases of industrial operation.

Courses

In the main the college will, as previously stated, continue as a liberal-arts institution. The courses are to be determined, however, by the best judgment of present values rather than by tradition. Antioch will give more than the traditional weight to subjects that inevitably affect us and a knowledge of which assist us to direct our lives and our times, and proportionately less weight to other topics. After careful consideration of the purposes of a cultural course—to put one in possession of the great contributions made by the outstanding figures of human history, and to give one the ability to analyze and to classify facts—it has been determined that the object can be achieved by about 80 courses, a course consisting of the equivalent of three recitations per week for a semester of eighteen weeks. This is in striking contrast with the 200 or 300 courses commonly offered by small colleges.

If objection be made to the combination of a liberal-arts course with practical training in administration, on the ground that the latter type of training is not necessary when merely a cultural development is desired, it should be emphasized that the training in self-reliance, in administrative methods, in economics and sociology, which form the common elements of the vocational courses to be given at Antioch, will not be without value in any walk of life.

While the courses are planned for co-operative work, the full-time student can fit into the regime with perfect ease by taking half of his subjects with each shift. Instead of alternating between work and study, he will alternate between two groups of study. The courses can be completed by the full-time student in four years; the co-operative student will normally require six.

Technical and Vocational Courses

A number of technical courses, aimed to offer a limited number of students training for specific callings, are to be given. Several considerations, in which

engineers will be interested, have entered into the selection of these courses:

The technical and vocational courses contemplated include business and industrial administration, machine-shop operation and management, accounting, contracting, civil engineering, farming, education as applied to consolidated rural schools, and household management.

Technical and Vocational Courses

Several considerations, in which engineers will be interested, have entered into the selection of these courses:

1. They should to the fullest possible extent represent an essential contribution to public education in America—a contribution not being duplicated elsewhere.

2. They should be courses which gain rather than lose by being offered at a small college, where highly specialized equipment and faculty are not available.

3. They should belong to a single general class, so as to contain the greatest practicable proportion of common factors, thus simplifying the curriculum and reducing expense, while to the fullest possible extent retaining value for persons of widely varying aims.

4. They should be courses which will profit to the fullest extent by the peculiar location or policies of the college, the pertinent factor in this case being the policy of alternation of work and study, and the type of faculty and organization which that policy involves.

5. It is an aim of the Antioch program to develop a spirit of responsible citizenship. The courses are aimed to prepare students for environments where certain types of social service are peculiarly needed.

6. They should be courses the training for which will have the widest possible usefulness and application.

The principle set forth in item 6 needs elaboration. Some persons of college age have such unmistakable and well-matured vocational bent that they may without danger of mistake commit themselves to specific vocational training. Other persons never do develop highly specialized ability, but would succeed approximately as well in any one of several callings. With such persons also, definite commitment to a calling during college years is sound policy.

There are still other persons who finally give evidence of highly specialized ability, but with whom the possession of such ability, or the opportunity to use it, does not become clearly evident until during or after college years. It is the aim for Antioch to have vocational courses which to an unusual degree will discover to students their comparative abilities in various callings, and the contents of which will have the greatest possible residuum of value to the person who later may be diverted to some other calling than the one for which he was trained.

It is planned that the technical and vocational courses shall have the common aim of training for general competence rather than specialized technic, for administrative ability, for proprietorship or directorship; in general, training for ability to be self-directing, and for ability to administer industrial, professional or commercial enterprises. This type of training will have such wide and general applicability that even should the student fail to continue work in the line of his specific vocational training, as so frequently is the case now with technical students, that training nevertheless will have high value in almost any calling.

In the professions, for instance, technical skill h... run so far ahead of administrative organization th... today increase in administrative efficiency is of th... greater moment. The average doctor, lawyer, engine... or educational administrator could increase his tot... productiveness two or more times if his administrati... practice were on a par with his technical skill. In com... merce, manufacture, contracting, mining, and most othe... callings dealing with material production and distribu... tion, efficient administration is needed at least as muc... as any other service.

There are two ways of arriving at the position o... administrative head of an important institution. On... is by "starting at the bottom" of that or a similar in... stitution and burrowing through it to the top. The... other method of arriving is by going over the top; by... beginning as a small self-directing unit, going from... the top of one organization to the top of another. Both... of these are necessary and standard methods of pro... cedure.

The Antioch program aims to prepare for the latter... method of progression by preparing a selected group... of students, through part-time study, combined with... part-time work in which initiative and self-reliance are... necessary, for becoming the responsible heads of small... institutions. After becoming the head of a small in... stitution the Antioch trained person would be equipped... to go as far as his innate quality would make possible... There are definite advantages in this method of ap... proaching administrative responsibility. Progress from... the start depends upon the use and growth of in... dividuality, whereas "starting at the bottom" in a big... organization frequently puts a premium on conformity.

Moreover, the administrator sees all phases of in... dustry. If he has not yet discovered himself he has... a prospect for doing so in his contacts with various ele... ments of his work. Many a man by "starting out for... himself" has discovered his real genius in selling or... in research or in some other specific field opened to... him by his experience.

An example of the possible usefulness of the Antioch... training is afforded by the proposed course in machine... shop operation and management.

All American industry and notably agriculture is be... coming increasingly mechanical. While the factories... of our country are turning out an enormous mass of... mechanical appliances our maintenance system, outside... of large cities and the maintenance of transporting... equipment, is limited to the infrequent machine shop... and to the service departments of a few industries... There is room for a large number of independent ma... chine shops for maintaining this equipment and other... wise for serving the mechanical needs of the communi... ties. Such machine shops would not be "blind-alley"... industries, for it takes but a slight change to turn a... well-organized shop into a factory and its manager into... a manufacturer.

The course in machine-shop operation and manage... ment would have as an underlying requirement the... essentials of a liberal-arts course. The student should... become a cultural and social asset to the community... as well as an industrial asset. By half-time work... through a six-year course, covering the different phases... of his prospective industry, he may gain some of the... experience necessary to make him an effective techni... cian, a superintendent and an executive. His techni... cal studies would include the fields of physics and

mechanics, business administration and accounting, psychology and sociology. After graduation he would at once undertake the management of a small machine shop, or would serve an apprenticeship in such a shop, depending upon his maturity and ability.

Selection of Students

The success of the new plan will depend as much upon the quality of the students and their success after graduation as upon any other single element involved. Therefore, the selection of the student body will be given relatively much more attention than in the ordinary school.

It is the plan to advertise as widely as possible just what is to be attempted in the way of a course, with the idea that the number of applicants shall be as large as possible. From this large number a very careful examination will select those persons who seem likely to make the most of the opportunities offered. Much more time and money per capita will be spent in selecting the freshman class than is spent in the larger institutions, since the need of selecting with care is so apparent. The examinations will be directed toward determining the quality of mind, industry and initiative of the applicant and less emphasis than usual, in proportion, will be given to the completion of a high-school course. It is recognized that a certain minimum of knowledge of facts is required, but it is more important that the student give promise of becoming a man of high intelligence, sound character, and balanced personality.

Faculty

Obviously the recruiting of a faculty for an institution based on such ideas is not an easy one. The faculty must necessarily be in harmony with the spirit of the institution.

For the vocational work tentative arrangements have been made, dependent in some cases on financing, with four or five men, who also are pioneers and who have records of orderly, successful accomplishments. With one exception they have not been professional educators. They are men who could not be attracted by purely academic work, but can be interested because they will be responsible for the economic and professional stability of the practical undertakings. Though they have not been professional educators each one of them is a great teacher, each one having tested capacity for imparting knowledge and outlook.

In the search for academic members of the faculty there has been much discouragement. A thorough canvass is being made in an effort to find about a dozen men who, along with scholarship, have the necessary originality and virility. Individual ability alone would not be sufficient. The curriculum must be a synthetic whole and a genius who cannot do teamwork will not fit into the Antioch faculty.

Trustees

For the direction of the college there has been secured a board of trustees on which a wide variety of ability is represented. The following are the members of the board:

Dr. F. C. Caldwell, professor of electrical engineering, Ohio State University; William Chryst, chief engineer, Dayton Engineering Laboratories Co.; Homer Corry, attorney, Springfield, Ohio; Joseph P. Cotton, of the law firm of McAdoo, Cotton and Franklin, New York; Henry S. Dennison, president, Dennison Manufacturing Co., Boston; George Drake, retired merchant, Yellow Springs, Ohio; Edward F. Gay, formerly dean, Harvard School of Business Administration, now president, New York *Evening Post;* Jerome D. Greene, of Lee, Higginson & Co., bankers, Boston; John C. Haswell, president, Dayton Malleable Iron Co.; Milton F. Hosea, attorney, Cincinnati; Ralph Howell, farmer, Yellow Springs; John H. Hunt, research engineer, Dayton, Ohio; General J. Warren Kiefer, banker and lawyer, Springfield, Ohio; C. F. Kettering, chief engineer, General Motors Co.; George Little, manufacturer and banker, Xenia, Ohio; William Mayo, chief engineer, Ford Motor Car Co., Detroit; Arthur E. Morgan, civil engineer, Dayton; Gordon S. Rentschler, active head, Hooven, Owens, Rentschler Co., Hamilton, Ohio; Ellery Sedgwick, editor, *Atlantic Monthly;* Frank D. Slutz, head master, Moraine Park School, Dayton; George M. Verity, president, American Rolling Mill Co., Middletown, Ohio, and Frank A. Vanderlip, banker, New York.

Plans have now progressed so far that the new plan will be put in operation in September, 1921. Obviously, it cannot be put in operation in its entire fullness then, but it is hoped that the main lines of work can be started. It is expected that accommodations will be available for about 600 students.

How Engineers Can Help

Engineers who may find interest in this plan can assist materially in the development of the idea and of the school. Engineers might, for example:

1. Suggest suitable students. The college is already building up a list of prospective students who will enter as freshmen during the next few years. An acquaintance for some time in advance will help in making an intelligent selection. Students are desired from every part of the country. In other words, it is believed that the institution should have a national influence.

2. Suggest types of industries which it might be possible to have located near the college, and which would combine earning capacity and educational value.

3. Suggest particularly suitable members for the faculty.

4. Discuss the program so as to help the members of the faculty and the trustees to fortify themselves against weak points and to further develop the best features of the plan.

Engineers are accustomed to casting aside prejudice and considering plans on their merits. If the members of the profession will do that in the present case they can be of material assistance in developing a plan that may eventually have an important bearing on American educational methods.

Housing Conditions in Prague

In order to provide immediate means of dealing with the housing crisis in Prague, Czechoslovakia, the police authorities have decided that not more than one room per person shall be lawful in apartments and dwelling houses. Every householder is required to report the size of his dwelling, together with the number of persons occupying it, according to a recent issue of *Commerce Reports.* Those who have spare room are required to share it with others. In the meantime, however, it is deemed essential to stimulate building.

Digest of Joint Committee's Uniform Vehicle Law

AT THE National Conference on Highway Traffic Regulations held in Washington, D. C., Jan. 10-12 (see news section) frequent reference was made, in the discussion of a proposed bill presented at that meeting, to a "Proposed Uniform Vehicle Law" which had been prepared last year by a joint committee, of which H. G. Shirley was chairman, representing the American Association of State Highway Officials, the National Automobile Chamber of Commerce, the American Automobile Association and the Highway Industries Association. A digest of this joint committee's proposed law is given below, inasmuch as the new bill offered at the Washington meeting was, in its essential features, a practical duplication of the joint committee's measure, of which from 30,000 to 40,000 copies in printed form have been distributed.

Chief Provisions of Joint Committee's Law

A commissioner of motor vehicles is provided for; he may be the secretary of state, state highway commissioner or any other duly elected or appointed official. He may appoint assistants and deputies to enforce the provisions of the act, the power of dismissal, in the latter case, resting with the vehicle commissioner.

Registration is required of all vehicles operating upon state highways.

The bill contains a three months' reciprocity clause.

Fees for the registration and licensing of vehicles are in accordance with the following schedule:

MOTOR VEHICLES

Equipped with:	Per Hp., Cents	Per 100 Lb. Gross Weight of Vehicle, Load, Cents
Pneumatic tires	25	25
Solid tires	25	35
Iron, steel or other hard tires	25	50

Motor vehicles used for the purpose of transporting persons for hire shall pay double the above rates.

TRACTORS

Equipped with:	Per Hp., Cents	Per 100 Lb., Weight, Cents
Pneumatic tires	25	25
Solid tires	25	35
Iron, steel or other hard tires	25	50

Tractors used for agricultural purposes shall pay one-tenth of the above rates.

TRAILERS AND SEMI-TRAILERS

Equipped with:	Per 100 Lb. Gross Weight of Vehicle and Load, Cents
Pneumatic tires	15
Solid tires	25
Iron, steel or other hard tires	35

Motorcycles ..... $5.00 each
Motorcycle sidecars ..... 5.00 each
Horse-drawn vehicles ..... 3.00 each
(Except those used for agricultural purposes and for transportation of passengers not for hire.)
Weighing not more than 1,000 lb., unloaded..... $3.00
Weighing more than 1,000 lb., unloaded..... 3.00
for first 1,1000 lb. and 50c. for each additional 100 lb. weight of vehicle.

Horse-drawn vehicles used solely for agriculture shall pay one-half of the above rates.

Motor Vehicle and Tractor Manufacturers and Dealers.
Registration and first five sets or pairs of plates.... $25.00
Each additional plate 2.00

Trailer, Semi-Trailer and Motorcycle Manufacturers and Dealers.
Registration and first five plates..... $20.00
Each additional plate 2.00
Pupil's permits ..... $1.00 each
Operators' and chauffeurs' license..... 2.00 each
Duplicate licenses ..... .50 each
Duplicate plates ..... 1.00 each

Horsepower is computed as follows: Square the bore of the cylinder in inches, multiply by number of cylinders and divide by 2.5.

Load plates showing the actual weight of the vehicle with equipment and the weight of the seating or loading capacity of such vehicle as specified by the manufacturer are required.

Size—The size restrictions specified are: Width, 96 in. (except traction engines which are limited to 108 in.) height, 12 ft. 6 in.; length, 30 ft. No combination of vehicles is to exceed 85 ft. in length, except in special cases where permits are required.

Weight—Weight restrictions are as follows: Four-wheeled vehicles, 28,000 lb.; limit of axle load, 22,400 lb.; limiting weight per inch width of tire, 800 lb.

Speed—Speed restrictions are specified as follows:

VEHICLES DESIGNED FOR CARRYING NOT MORE THAN SEVEN PASSENGERS

Max. Wt., Including Gross Wt. of Vehicle and Load	Open Country Highway	Suburban Street	Urban Street
6,000 lb.	30 miles	20 miles	15 miles
Other vehicles, equipped with pneumatic tires			
6,000 lb.	25 miles	20 miles	15 miles
8,000 lb.	25 miles	20 miles	15 miles
12,000 lb.	25 miles	20 miles	15 miles
16,000 lb.	25 miles	20 miles	15 miles
20,000 lb.	25 miles	20 miles	15 miles
24,000 lb.	25 miles	20 miles	15 miles
28,000 lb.	25 miles	20 miles	15 miles
Vehicles equipped with solid tires			
4,000 lb.	25 miles	20 miles	15 miles
8,000 lb.	20 miles	18 miles	12 miles
12,000 lb.	18 miles	15 miles	12 miles
16,000 lb.	16 miles	15 miles	12 miles
20,000 lb.	15 miles	15 miles	12 miles
24,000 lb.	15 miles	15 miles	12 miles
28,000 lb.	15 miles	15 miles	12 miles

All moneys received by the vehicle commissioner for licenses, penalties, etc., are to be used for the maintenance, repair and construction of highways and for other purposes prescribed by law.

Suggests Higher Working Stresses for Steel in Building Frames

Speaking on "Reducing the Cost of Steel Frame Buildings" before the Western Society of Engineers on Jan. 10, R. Fleming proposed an increase of the usual working stresses for steel in building work to a higher value, suggesting 18,000 lb. per square inch for tension and the equivalent in compression. He based this suggestion on the claim that processes of steel manufacture and workmanship in fabrication have improved greatly during the past few years, and that in spite of this we are still using the same working stresses as twenty years ago.

Other elements of cost reduction discussed in the paper are reduction of excessive building code requirements, chiefly in floor loads and wind pressure; good judgment in designing, to avoid using an unnecessary number of sections, to produce the largest possible amount of duplication and to avoid forge work, etc.; suitable detailing so as to avoid bevel cuts and other costly items of shop work; reduction of number of rivets in compression members; subdivision of the structure in such a way that the parts can be shipped in the most economical manner, taking into account reduction of freight charges and increase of erection cost when trusses and the like are knocked down; simplifying the work of the erector; and using care to avoid delays or missteps in the entire process from designing office through drafting room and shop to the finished structure, on the ground that the time element is closely related to the cost of a structure. Mr. Fleming also raised the question whether alloy steels might not be found economical in either industrial buildings or office buildings, but presented no facts or recommendations on this point.

Engineering Problems in Bubonic Plague Control

By Edmund B. Besselievre
Consulting Engineer, New York City

BUBONIC plague control is largely an engineering problem. Fortunately the U. S. Public Health Service, which in all cases handles the work of eradication, in connection with state and city health agencies, has recognized this fact and one of the two executives in each district where plague measures are carried on is an engineer.

Since the rat flea is responsible for the spread of this dire disease to human beings the first measure of plague control is the elimination of the rat. This work is done by intensive and systematic trapping by volunteer or paid trappers, with bonus for each rat caught; by poisoning; by fumigation of premises known or suspected to harbor rats; by intelligent wrecking of useless shacks and structures offering excellent harborages; by starvation of the rat through deprivation of his food supply; by rendering food inaccessible and by proper disposal of waste matters; and lastly and more surely by proper rat-proofing all buildings and structures—"building out" the rat. The first essential for successful operation of the "building out" method is to educate the citizens and arouse their civic pride so that they will keep their premises, and thus their city, free from rats.

HOUSE IN BEAUMONT, TEX., REQUIRING NO CHANGES FOR RAT ELIMINATION

Floor more than 18 in. above ground and no rubbish accumulations.

The paid trapping, poisoning and fumigation measures when plague is present or feared are usually done by the U. S. Public Health Service, the State Board of Health, the Health Department of the city concerned, or all three jointly. In none of these is special engineering knowledge required. When it comes to rat-proofing of houses, office structures, warehouses, railroad freight depots, wharves and docks the studies that should be made preliminary to the preparation of plans and regulations for carrying out such work with the least inconvenience and cost to property owners are essentially the work of the engineer.

To determine how to rat-proof any one of these structures without needlessly destroying its usefulness for a considerable period of time by extensive rebuilding, with the expenditure of large sums of money, is a problem. To decide whether a dwelling house which perhaps only slightly violates the regulations, can be made to conform by some slight alteration at little cost or whether it must be elevated or a concrete wall built around it requiries that degree of common sense which is the basis of all good engineering.

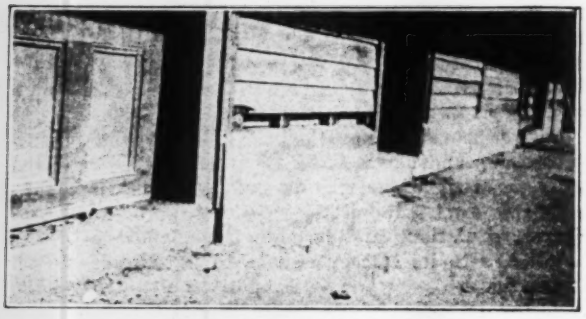
As it is usual, in municipalities afflicted with plague, to draw up and have passed an ordinance whereby the necessary regulations may be enforced it is important that engineering advice be secured both to ensure proper regulations and to gain the confidence of the citizens as to its efficacy and as to its fairness to all concerned.

As the main foci of plague in this country have been in towns and cities along the Gulf of Mexico and Pacific Coasts, in other words in warm climates, the structures affected by the rat-proofing measures have been mainly those without cellars or basements, thus simplifying the problem as compared with what it would be in our Northern seaport cities with their deep foundations, cellars and basements.

In the main the method of rat-proofing adopted in New Orleans, La., and in Beaumont, Tex., where plague made its appearance in 1920, has been the division of the work into two classes: (1) Stores and other business structures; (2) dwelling houses. The first has been carried out by destroying wooden floors laid on or slightly above the ground, affording rat harborage beneath, and laying concrete floors with side walls 12 or 18 in. high of the same material. This is not only a protective measure against rats but an insurance against dampness and other possible nuisances. The dwelling-house rules usually require that such structures be elevated not less than 18 in. above the normal ground level, left free and clear underneath, all rubbish removed, etc., and the space between the outer and inner house walls boarded up at the bottom. Or if the owner desires he may construct a concrete "chain wall" entirely around the house, extending 2 ft. below the surface of the ground and making a tight seal with the sills and baseboard of the house above the ground. This latter method is both the most effective and the most expensive, but as the elevation of a large or pretentious house sometimes spoils its appearance the "chain wall" alternative is adopted in many cases where expense saving is not a primary consideration with the owner.

These "chain walls" are 6 in. thick and provided with ventilation openings covered with metallic screening. Six inches is selected as the thickness in order to prevent the use of brick for these walls, as the Norway rat (the main plague bearer) will gnaw through an ordinary brick and mortar wall and has been known to burrow under walls 18 in. below the ground surface.

Yards, outhouses, garages, and other small structures are treated simply but effectively and at little cost. Rubbish heaps are removed, garbage is placed in closed cans, wood piles or fuel bins are placed on elevated platforms not less than 18 in. above the ground. Outhouses having wooden floors are either destroyed or if useful their floors are removed and the earth used as a floor or else concrete or boards are laid directly on the earth. (Garages must be floored either with boards or with concrete laid on the earth.) If loose boards are used they must be loose, so as to be easily removable for inspecting for possible rat holes beneath. The main object being to remove all dark harboring places of the rat, to whom sunlight is an abomination, and at



CHAIN WALL FOR SMALL STORE AT GALVESTON, TEX.

the same time continue the usefulness of business and home structures, it can readily be seen that practically enforceable regulations will go further in procuring the desired co-operation of the property owner than an arbitrary requirement framed without proper technical thought or influence. It is hoped, therefore, that the good work done so far along these lines, and the hearty co-operation of the medical and engineering professions, as exemplified in the organization of the U. S. Public Health Service in its work in New Orleans, Beaumont and Galveston, will be continued wherever and whenever evidences of plague make themselves felt in this or other countries.

Method of Computing Waste-Weir Capacity and Reservoir Rise

By W. S. Pardoe
Professor of Hydraulic Engineering, University of Pennsylvania
Philadelphia, Pa.

THE following method was used by the writer in computing the rise in head on a waste weir 250 ft. long for a reservoir of about ten square miles water surface in a catchment of 50 square miles located in the North Atlantic States.

As no time flow record of flood discharge of the river was available the rainfall curve shown in the diagram was constructed from the best obtainable data; the total rainfall in 48 hr. being 10 in. and the maximum rate being 2.5 in. per hour for the last hour of the storm. The rates of rainfall were assumed constant for 4-hr. periods for the first 44 hr. and then rates were assumed constant for 1-hr. periods.

Referring to the sketch: If Q_1 (i.e. inches per hour $\times$ 645 $\times$ 50) flows into the reservoir for the time dt and Q_2 (i.e., $3.6 \times 250 \times Z^{\frac{3}{2}}$) flows out during a like interval and A is the area of the water surface at elevation Z the relation may be expressed as follows:

$$Q_1 dt = A dZ + Q_2 dt$$

or

$$dt = \frac{A\,dZ}{Q_1 - Q_2} = \frac{m(a+Z)^n dZ}{Q_1 - 900 Z^{\frac{3}{2}}}$$

This expression looks mathematically integrable but it is very long and difficult and can be accomplished with sufficient accuracy by the following graphical methods:

$$\text{integrating } t = \int_{Z_1}^{Z_2} \frac{A\,dZ}{Q_1 - 900 Z^{\frac{3}{2}}}$$

if the function $\frac{A}{Q_1 - 900 Z^{\frac{3}{2}}}$ be plotted as ordinate and z as abscissa the areas under such a curve will be time in seconds.

The curve ab is for the fifth 4-hr. period. The area $a\,b\,c\,d$ is 80,500 $\times$ 0.179 or 14,400 sec. or 4 hr. during which period the reservoir rose from El. 0.615 to 0.795. The last four periods being of 1 hr. duration have an area of 3,600 seconds.

If the total rainfall is 10 in. and the final hourly rate 2.5 in. the final head on the weir will be 3.94 ft. and the discharge about 7,000 sec.-ft. This is very small compared with Q_1, which is equal to 2.5 $\times$ 645 $\times$ 50 = 80,600 sec.-ft. This is of course very excessive but the reservoir under consideration has an area of 20 per cent of the catchment area which has relatively steep and rugged hillsides and hence the assumption of 100 per cent flowing off land surfaces.

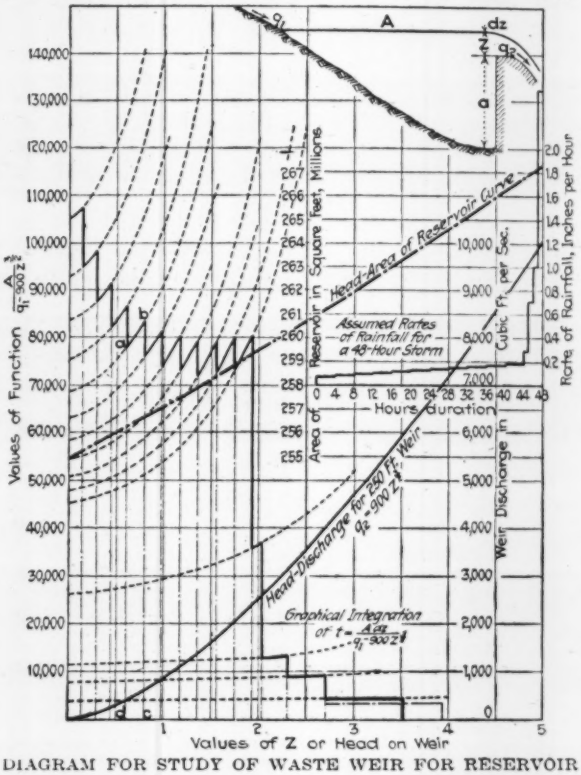

Values of Function $\frac{A}{q_1 - 900 Z^{\frac{3}{2}}}$
Area of Reservoir in Square Feet, Millions
Head-Area of Reservoir Curve
Assumed Rates of Rainfall for a 48-Hour Storm
Cubic Ft. per Sec.
Rate of Rainfall, Inches per Hour
Hours Duration
Head-Discharge for 250 Ft. Weir $q_2 = 900 Z^{\frac{3}{2}}$
Weir Discharge in
Graphical Integration of $t = \frac{A\,dz}{q_1 - 900 Z^{\frac{3}{2}}}$
Values of Z or Head on Weir

DIAGRAM FOR STUDY OF WASTE WEIR FOR RESERVOIR

Some Notable Americans Who Were Surveyors

The following paragraph on notable Americans who "at some period of their lives" were surveyors has been extracted from Guy Emerson's "The New Frontier" and sent to this journal by John Nolen, city planner, Cambridge, Mass.:

It is an interesting fact that some of our most characteristic Americans have been surveyors at some period of their lives. This list includes Washington, Daniel Boone, Andrew Jackson, Thoreau, Lincoln. One of the fundamental things about a surveyor is that he blazes a trail; that he defines boundaries which hitherto have been vague and in dispute. A surveyor in the first place must be accurate, and in the second place he must be self-confident. He must be undismayed by any temporary obstacles and barriers which stand between him and his objective. There is something particularly appealing in this type of man in this age of problems so varied and difficult of definition, with so many human and material variants.

Germany's Dominant Industrial Issues—the Silesian Plebiscite and Coal-Mine Control

Loss of Silesian Coal and Zinc Faced—Shortage Forces Use of Coal Substitutes—Impending Socialization of Mines May Furnish Key to All Industrial Control — Low-Head Water-Power Development Active

(By Engineering News-Record's Berlin Correspondent)

GERMANY is facing two great problems, the outcome of which will have a very strong bearing upon the shaping of the country's future, and which, therefore, occupy the public mind to the exclusion of almost everything else. These issues are the fate of Upper Silesia and the socialization of the coal mines.

Upper Silesia is one of Germany's largest industrial and agricultural provinces, surpassed only by Westphalia and Rhineland, in fertility of the soil and possession of mineral wealth. It contains one of the most extensive coal deposits not only of Germany, but of the continent of Europe, contributing about one-fourth of Germany's total yield. The annual output of coal in 1913 was 43,000,000 tons, valued at 516,000,000 marks, and is at present 35,000,000 tons valued at 5,950,000,000 marks. Though slightly inferior to the Westphalian coal, it is of good quality and forms the basis of great manufacturing activity. Numerous industrial manufacturing works have settled down upon or near the coal mines. The district from Beuthen to Gleiwitz is densely covered with iron works, zinc foundries, machine shops, etc. The country contains sixty-five coal mines, seven iron mines, eight blast-furnace works, twenty-five foundries, fourteen rolling mills, and fifty-nine machine shops. The province also has iron deposits near Oppeln, which produced in 1919 460,000 tons of pig iron, and zinc mines near Beuthen, which are probably the richest of the world. Other mineral products of the country are lead, silver, copper, cobalt, arsenic, cadmium, alum, lignite, marble, etc. It produces the best portland cement and is one of the largest timber lands of Germany. It is therefore invaluable to the building industry.

It will shortly be decided by plebiscite whether the province shall in the future remain with Germany or fall to Poland. The loss on the one side, and the gain on the other is so great that both claimants are straining every nerve to retain or obtain possession of it. Political strife is at present running very high and the result is very much in doubt. The Polish population, though but a small minority, taking the country as a whole, is concentrated in the industrial district, where it probably forms the majority. Germany, therefore, stands in danger to lose this, the most valuable part of the province. Such a loss would greatly impair her economic strength, although it is an exaggeration to pretend that it would seriously cripple her, as the political propagandists maintain. The loss of all or part of the province, although severe in its immediate effects, would no doubt be an additional stimulus to the development of unexploited surface and underground resources, which is Germany's task in the future, and which has lately been taken in hand with surprising energy.

The other problem, that of the socialization of the coal mines, is just as momentous, although it lies in a different direction. Its import goes far beyond the immediate result it might have. The present strife will decide which course the country will take with regard to socialistic doctrines and the working classes in general. If defeated in this, socialization will be, if not a thing of the past, a matter of a rather remote future. Conditions for radical measures against the coal owners are exceptionally favorable. The control of the mines has passed into the hands of a comparatively few men, who have accumulated enormous wealth and influence, of which not always wise use is made. While the impoverished population is made to suffer under the increased cost of fuel, the annual reports of the mines openly show gains of a magnitude before unheard of, with still larger profits hidden behind the screens of intricate accounting. Even the bourgeois class, therefore, supports the demand of the workers to convey the coal-mining properties into commonwealth possession.

Proposals of Operators and the Government

The mine owners, on the other hand, put forward strong arguments against socialization. Experiences with socialization, they maintain, have as yet been very discouraging, from a financial as well as production standpoint. The strides the country can make toward economic recuperation strongly depend on the increase of the coal production, in view of the loss of the Sarre district, the possible loss of the Upper Silesian mines and the heavy coal tribute to the Allied countries. The mine owners claim that private enterprise is indispensable to this task, especially when considering the run-down condition of the mine equipment, the necessity of modernizing it, sinking new shafts, requiring a capital investment, and an amount of high-strung energy which red-tape state administration never could command. The result of socialization would, so they argue, be a decline of coal production which ultimately would mean disaster.

The present non-socialistic government is acting very half-heartedly in the matter. The socialists, while in power, treated the socialization problem very gingerly, and moved away from it as far as it seemed safe, but since they are out of government they have made it a party platform, urging the government to make good the promise which they themselves had made. The government, attacked by two factions—the socialization advocates and their opponents—is in a rather helpless position and takes recourse to lengthy committee deliberations and expert opinions. Two bodies, the *Reichswirtschaftsrat* or National Economic Council, and the *Reichskohlenrat*, or National Coal Council, have been deputed to collaborate in the preparation of the matter for parliamentary decision. The official proposal of coal socialization is the work of Professor Lederer, the reputed economist of the Heidelberg university. It demands expropriation of the mine owners against payment by government bonds, and complete control by state administration, totally eliminating the present owners. Another proposal submitted by Rathenau, gen-

eral manager of the A. E. G. Electric Co., attempts to strike a compromise. It will give the state control of the coal distribution, leaving the mines in the hands of the present owners for a period of thirty years, after which they shall become state property absolutely and without compensation. The danger of the mines being run down during that time is to be avoided by paying premiums on increased production and by leaving part of the latter at the free disposal of the mine owners. There are one or two other proposals, inspired like Rathenau's, to continue private enterprise but keep it under control.

Combines of Electrical Coal Users

In strong contrast to these proposals is that of the mine owners, submitted by Stinnes, an industrial leader of great wealth, power and astuteness. He proposes, if any change of the existing conditions be decided upon, to put the consumers in control of the coal mines and not the state as a whole. He would form co-operative combines of all large consumers like electricity works, power plants, etc., which would acquire the controlling interest in a number of coal mines, sufficient for their supply. The individual members of such combines would vary in proportion to their needs for coal. In the case of small consumers there would necessarily be more members than in that of larger consumers, who, it is recommended, should amalgamate with individual mines. Private enterprise would, so Stinnes says, in this way be maintained and the interest of the consumers safeguarded. Furthermore, the consumers would constantly be on the alert to increase the production and would, by combined strength, be able to find the necessary capital for extensions and new equipment. To reconcile the miners with this very non-socialistic proposal, he recommends the creation of small-capital shares of 100 marks denomination, which are to be reserved for the miners to be paid for from their earnings. The miners would in this way become part owners of the mines, and be able to exercise some control. Stinnes' proposal is of course strongly supported by all capital interests and by manufacturers. A large program of propaganda is being made to win the miners over to this plan with promises of betterment. It is, however, very doubtful whether the working classes, saturated with fifty years of socialistic propaganda, will acquiesce. Agitation is running very high, but the public interest is already diminishing and it may be quite possible that the whole matter will either be shelved for some time or end in a compromise, which, while saving appearances, will leave things pretty nearly unchanged in substance.

"Vertical Trusts"

In the meantime Stinnes' proposal is in a fair way to become a matter of fact, if not of law. The process of amalgamation which he recommended has, during the last few months, progressed with surprising speed. Its trend is to link together producers and manufacturers of all lines of goods, from the coal mine up to the finished product. The expression "vertical trust" has been coined here for such combines, intended to indicate that the combines follow the manufacturing process from the lowest stage to the highest, in contradistinction to existing trusts, which combine manufacturers of the same stage. Vertical trusts not containing business rivals will not concern themselves with the control of prices. Their chief interest will be economic production whereby the various members will stimulate one another, and each member will be in a position to profit by the experiences of the others. A number of such trusts have lately been formed amongst very large works. Noteworthy is the huge combine entered into between the works under Stinnes' control and the Siemens group, in itself a combine of large dimensions. The Stinnes combine now comprises the following works: *Deutsch-Luxemburgische Bergwerks und Hütten-Akteingesellschaft, Gelsenkirchener Bergwerks-Aktiengesellschaft, Bochumer Verein für Bergbau und Gusstahlfabrikation,* and *Gebrüder Böhler Aktiengesellschaft.* These firms own coal mines, steel works and machine shops. Their present capital is quoted at 1,400,000,000 marks. The Siemens group consists of the following firms: Siemens & Halske, Schuckert & Co., Siemens-Schuckert G.m.b.H., Bergmann Electricity Works, and five subsidiary companies. Their capital value is almost equal to that of the Stinnes combine.

Trusts of this kind are an entirely new departure and indicate that the trusts and syndicates of former times formed to control prices and to distribute production have been abandoned. This will ultimately end in the fusing together of German manufacturers into groups and in the disappearance of the individual manufacturers. These groups will amongst themselves represent an imposing phalanx against government and outside interference.

Production of Coal Substitutes

The coal problem in its various aspects is the motive power of another development which is taking more and more concrete shape and which will, if nothing untoward happens to the country, take huge dimensions in the future. Coal is now Germany's chief national wealth. Coal exports will, for a long time to come—far beyond the last export of reparation coal called for under terms of the peace treaty—be the chief factor of Germany's own reconstruction. Germany's chief aim in the future will, therefore, have to be directed toward using as little coal for home consumption as possible, and to find the necessary substitutes through the exploitation of the other power-producing agents, i.e., water power, brown coal and peat. Considerable progress has been made in this direction during the last five years under the exigencies of the war. Germany possesses very extensive deposits of brown coal, which can be produced by surface mining. These deposits occupy a belt stretching from the Cologne district through the middle parts of Germany almost to her eastern borders in Silesia.

This brown coal has been considered of too poor a quality to bear the expenses of long-distance transport, but pressed into briquettes it forms a valuable part of the household fuel in districts removed from the coal mines. Its most economic use, however, is the generation on the spot of electric power and its transmission to power consumers within certain radii. Large power plants of this kind were erected during the war, a notable example being the power plant of Golpa, supplying practically all Berlin, 80 miles distant, with electricity. Power units developing up to 75,000 hp. have been put up on brown-coal fields, and manufacturing works needing large quantities of power like electrochemical plants have settled down near the brown-coal mines. The further development of brown-

coal mines intended to replace coal-power plants within a wide circle is the aim of the government and strong efforts have been made in this direction. The Spa Treaty has been an additional stimulus. The emancipation of electric power plants and manufacturing works from coal supply, and their shifting on or near brown coal deposits will no doubt be a dominant feature in the near future.

A similar development may be observed, although in much lesser degree, with regard to the peat districts in the northern provinces of Germany. Considerable experience has been gained in the use of peat as a fuel, and the power plants using peat have been quite successful. The richest peat districts are in parts of the country devoid of any other resources. They cannot be reached by long-distance transmission from the brown-coal fields, have no water power, and rail transport makes coal very expensive, quite apart from its shortage. Germany's dried peat resources are estimated at 10,000,000,000 tons, enough to feed all public electricity works existing in 1917 for 150 years, and to run all German railroads by electric power for 220 years. A number of large peat central power stations are under contemplation. The designs are finished and approved, and the projects are awaiting financing.

Peat and Water Power

Similar efforts are made in the south of Germany toward the utilization of water power. Germany possesses ample water power, which can be utilized at no great cost, and of which only 10 to 15 per cent has been utilized. This water power was formerly estimated at 1,500,000 hp., but close investigations carried on during the past year show, according to a statement made by Building Councillor Schmicke, that 6,000,000 hp. can be produced. This water power is equivalent to 37,000,000 tons of coal, equal to one-third of Germany's present coal production, and valued at the present coal price at no less than 13,000,000,000 marks. Two million horsepower are to be found in Prussia, 3,000,000 in Bavaria, and the rest in the smaller countries in South Germany and Saxony. This high estimate of Germany's water-power resources, differing so far from pre-war figures, is due to the discovery, lately made, that under the present circumstances it will pay to develop not only high-, but low-head prospects, the latter encountered in connection with the construction of shipping canals. Germany has a number of canal projects, which have formed part of the governmental inventory of one or two generations. These projects, intended to connect the various river systems, like the Rhine with the Danube, the Elbe with the Weser, and so on, have so far as memory goes been talked about, but never been taken in hand seriously. It seems that what years of abundance could not produce will now be achieved under the stress of sheer necessity. A bill authorizing the construction of the so-called Midland Canal (*Mittelland-Kanal*) has just passed the Prussian Diet. This canal will be an extension of the Rhein-Weser canal to the Elbe, which latter it will join near Magdeburg. Branch canals will connect it with the important towns Braunschweig and Leipzig. By the same bill the completion and enlargement of the Ihler and Lauer canal, and of the canal connecting the rivers Oder and Spree, has been decided upon. The cost of this work is estimated at 306,000,000 marks. The Midland Canal will be built for ships up to 1,000 tons. A considerable amount of electric power can be obtained between the canal levels and by the regulation of the tributaries in connection with the canal construction.

Miscellaneous Projects

The Rhine-Danube canal project has also reached decisive stages. This canal is of continental importance as it will open up an inland waterway from the North Sea to the Black Sea. It is estimated that 170,000 hp. of hydro-electric power can be obtained from this canal, which would pay a large part of the interest on the capital investment. Other plans of a similar kind are: (1) The regulation of the Upper Rhine between Lake Constance and Bâle for navigation purposes, through which 800,000 hp. are obtainable; (2) and further regulation of the Weser and Oder, each estimated to net 24,000 hp. of hydro-electric power. Hand in hand with these large plans for developing inland navigation goes the plan of the city of Cologne to build an extensive harbor.

Since the armistice Cologne has become of great commercial and industrial importance. Its present harbor facilities are by no means adequate. The new harbor will have quays four miles long, a water area of 3,000,000 sq.ft., and a warehousing area of nearly double that amount.

These huge projects are of course very much a matter of the future, and it is difficult to see where the money to pay will come from. The population is, however, now so convinced that all these projects are necessary for Germany's future prosperity that, no doubt, public loans will find ready support. From the energy devoted to the completion of the large Bavarian hydro-electric plants and their astonishing rate of progress, it can be assumed that the engineers and the contractors will soon be kept busy for a long time ahead.

The Bavarian hydro-electric plants now under construction comprise the following:

Plant	Horsepower	
Waldensee	144,000	(maximum)
Isar	87,000	"
Inn	75,000	"
Lech	117,000	"
Alz	29,000	"

All these projects will bring relief, too, in the matter of the unemployed, the number of which, although declining lately, is still very large, and who are a considerable burden upon the country. The time when the metal industry, overgrown during the war, will be reduced to normal size, has come, and numberless workers formerly employed in the building industry are looking for employment at their old trade. It is hopeless to expect a revival of private building activity yet, as long as rents are only slightly above pre-war level while the building costs have soared up to from twenty to thirty times of the pre-war level. Public utility works only, can therefore relieve an otherwise very difficult labor situation.

The Building Industry

At present the employment of the building industry leaves very much to be desired. Only a part of the contractors—mainly concerned with public work—can be said to be busy. Some very large contracting firms, amongst them Philip Holzmann of Frankfurt, have informed your correspondent that they are having a

very slack time. This is confirmed by recently issued figures of the employment of the German structural steel builders in their business year from July, 1919, to 1920. Only 143,000 tons of steel structures were erected during that time compared with 412,000 tons in 1913-1914. The number of employees and workmen employed with this association has, however, almost reached that of the latter business years. The production of building material, except bricks, has advanced even beyond inland consumption. It is noteworthy in this respect that the embargo on the export of cement has been withdrawn. The cement industry is suffering under the coal shortage, and the production has gone down considerably. Still there is more produced than the country consumes. With regard to private building, strong efforts are being made to reduce the cost of building by labor- and coal-saving devices and materials.

PRESENT PRICES

Wood	1,000 marks per cubic meter
Structural steel	2,500 marks per long ton
Ferro-concrete	1,800 marks per cubic meter
Concrete	200 marks per cubic meter
Ferro-concrete wire	2,850 to 3,150 marks per ton

Many such materials have been put on the market, backed by extensive claims, but so far none have been quite successful. The government has carried on experiments with adobe buildings, and is largely advocating their use for buildings outside of towns, especially for workmen's houses, although use of the material has found severe critics in engineering circles. Of all the various new materials the old slag brick made of cinder, cement and lime has so far proved the only one of lasting value.

Record of Production of Explosives in 1919

EXPLOSIVES manufactured in the United States during the year 1919 aggregated 417,634,470 lb., a decrease of 16 per cent from 1918, according to a report by Wm. W. Adams, issued by the U. S. Bureau of Mines.

These explosives are in three classes: 180,511,050 lb. of black blasting powder, 198,268,588 lb. of high explosives and 38,854,832 lb. of permissible explosives. Dynamite and all other high explosives of various trade names and compositions are classed as "high" explosives. In the "permissable class of explosives similar to samples tested by the Bureau of Mines and used in accordance with prescribed conditions; they include ammoniun nitrate explosives, hydrated explosives, organic nitrate explosives and certain nitroglycerin explosives containing an excess of free water or carbon.

PRODUCTION OF EXPLOSIVES, 1919

	Black Blast Powder, Kegs	High Explosives, Lb.	Permissible Explosives, Lb.
Coal mining	6,139,605	24,616,383	32,840,196
Other mining	252,134	89,754,788	2,498,132
Railway and other construction	204,197	12,759,623	183,353
Total	7,220,442	198,268,588	38,854,832

The most general uses of these explosives are shown in the accompanying table.

Highway Cost Analysis Simplified by Illinois Reports

Foreman Fills in Weekly Special Form, Showing Distribution of Costs—Local Bank Checks for Small Bills

BY I. E. SCOTT
Assistant Maintenance Engineer, Division of Highways

QUICK results in recording and analyzing highway maintenance costs in Illinois have been secured by using a maintenance foreman's report blank which is a time sheet and a disposition sheet of costs of labor, materials, supplies and repairs. In connection with this form of report simplicity and speed have been secured in paying small maintenance bills by means of a special voucher-check drawn against local banks in the maintenance districts. The illustrations show, Fig. 1, the form of check and, Fig. 2, the face and reverse sides of the report blank. Both forms are given in full, because they have proved to be time and labor saving devices of importance.

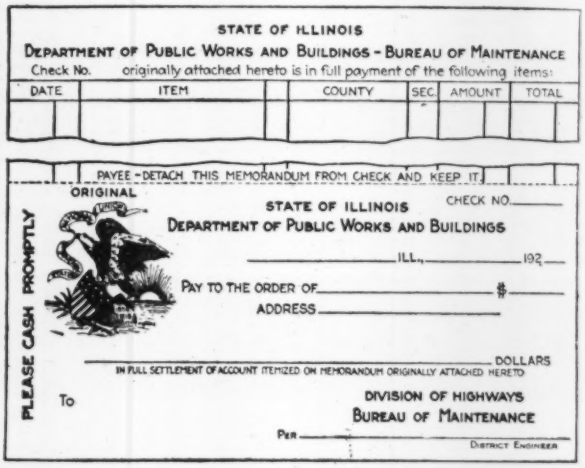

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS - BUREAU OF MAINTENANCE
Check No. originally attached hereto is in full payment of the following items:
DATE | ITEM | COUNTY | SEC. | AMOUNT | TOTAL
PAYEE - DETACH THIS MEMORANDUM FROM CHECK AND KEEP IT
ORIGINAL
STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
CHECK NO.
ILL., 192
PAY TO THE ORDER OF $
ADDRESS
DOLLARS
IN FULL SETTLEMENT OF ACCOUNT ITEMIZED ON MEMORANDUM ORIGINALLY ATTACHED HERETO
PLEASE CASH PROMPTLY
To
DIVISION OF HIGHWAYS
BUREAU OF MAINTENANCE
PER
DISTRICT ENGINEER

FIG. 1. LOCAL BANK VOUCHER-CHECK FOR SMALL BILLS

Small bills contracted by maintenance foremen for local labor, materials, and supplies are paid by check against local banks. This practice insures prompt payment, which assists the foreman in commanding quick service from dealers and in obtaining temporary laborers. An arrangement is had with one bank in each of the nine maintenance districts to handle the checks. The voucher-check for each district has printed on it the name of the bank for that district.

The maintenance foreman, with the report for his section, schedules all bills to be paid. He forwards the report, the schedule and all bills in duplicate to the district engineer, who checks them over carefully and then draws the voucher-check in payment. The checks are made up in pads in quadruplicate. The checks for each district are numbered consecutively, beginning at one, preceded by the district number. The original is printed on safety paper and the three copies are on yellow paper. All are made out at the same time and are identical. The original only is signed by the district engineer and is sent to the payee. When it is presented in a bank for payment the payee detaches the voucher portion which lists the items being paid by the check.

FORM No. 2

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS
BUREAU OF MAINTENANCE

District No.
County
Section — Route
Type of Pavement

LABOR

Month of 192

(Days of Week Here)

NAME	ADDRESS	Total Time Hours	Rate Per Hour	Amount Due	Method of Payment	Voucher Number	DISTRIBUTION OF COST: Pavement	Metal Shoulders	Earth Shoulders Ditches and Drains	Bridges and Culverts	General District Charges
Maint. Foreman	Salary										
Maint. Foreman	Expense—As Itemized on Other Side	Hours — Per Day Here									

MATERIALS AND SUPPLIES

Date	NAME	ADDRESS	Car or Truck No.	ITEM	Quantity	Unit Cost	Amount Due	Pavement	Metal Shoulders	Earth Shoulders Ditches and Drains	Bridges and Culverts	General District Charges

I hereby certify that the above expenditures were necessary for the maintenance of the road named.

If this is your Final Report for this section make an "X" here ☐

PASSED

SIGNED

Maintenance Foreman — District Engineer

Over

Condition of Pavement

Condition of Metal Shoulders

Materials Used from Storage

Kind — Quantity

Amount Remaining

Where Stored

Kind — Quantity

Amount Remaining

Where Stored

Bituminous Material Used on this Section — bbls.

Used from Storage — bbls. Amount Remaining — bbls.

Where Stored — Brand

Car and Truck Report
(To be made out weekly) Date 192

Number					
Condition					
Total Mileage to Date					
Total Mileage Last Report					
Total Mileage for Week					

Remarks

NOTE—This report must be sent in to the District Engineer at the end of each week. Report each Section or Combination separately. Do not combine except as instructed. When buying materials or supplies be sure to get bills in duplicate whether paid by you or not. When paid by you have them properly receipted. Send them with report when reporting the item. They must be OKed by you and approved by the District Engineer before same can pass for payment. Make proper distribution of all items. Do not put any item in column headed "General District Charges" except those items which cannot be considered a section charge. Items of supplies and repairs of a permanent nature or continued use and items of expense when incurred by bad weather or in long travel from section to section may be placed in this column. Care in making out these reports properly will greatly assist in making prompt payment of labor and bills incurred.

PERSONAL EXPENSE ACCOUNT

Date	LOCATION	ITEMIZED DAILY EXPENSE: Lodging	Breakfast	Dinner	Supper	TOTAL

FIG. 2. FACE AND REVERSE OF TIME AND COST DISTRIBUTION REPORT

At the time that the original check is mailed to the payee the district engineer mails two copies of the check with report, schedules, and all bills in duplicate, O.K'd. by him, to the head office. Upon receipt voucher is made up for warrant as a reimbursement to the bank upon which the checks are drawn for the amount called for by the checks. When the cancelled checks come to the bank and it has received warrant as reimbursement for them the cancelled checks are forwarded to the main office and are then attached to the original bills and voucher in the auditor's office. This completes the circle and eliminates a chance of discrepancy.

This method is working very nicely and permits prompt payment for all bills under $100. At times it results in the bank being out of the use of the money for a few days on some of the checks, but as frequently the bank receives its warrant of reimbursement before checks have been returned to it for payment. The fact that the state is not able to make a deposit with the banks as a checking account necessitates asking the banks for this accommodation.

As the checks are numbered serially and consecutively for each district it is necessary that every check be accounted for. If for any reason a check is mutilated or made void when being made out it must be sent in to the head office and accounted for. A check register is kept in the head office in which the check number, date of issue, the payee, amount of check, warrant number given as reimbursement to the bank, date of cancellation and date sent to the auditor's office are recorded. In this way positive check is kept on all checks issued.

Foremen Report Costs in Triplicate

A separate cost report is made each week for each maintenance section, or each group of maintenance sections when for a logical reason several sections may be combined into a maintenance group.

In making the distribution of cost the roadway is divided into four divisions: (1) The wearing surface or traveled way; (2) the metal shoulders, as some sections of pavement have metal shoulders and it is desired to know the cost of maintenance on them; (3) earth shoulders, ditches and drains; and (4) bridges and culverts, these being common to all sections. There is also a column for general district charges. It is intended that no cost be placed in this general district charge column except that which cannot be considered as a

section charge. At the end of the year the general district charges are pro-rated to the various sections of road in this district in order that these charges of general nature may not unduly weigh against some particular section.

On the reverse side of the sheet there is space for stating the condition of the pavement and of the metal shoulders. There is also a space for a record of material taken from storage and materials used on particular sections. Also a space was provided for a truck report to be made out weekly covering every car and truck used by this particular maintenance foreman. Finally there is a space for a personal expense account, as to date, location, lodging and meals. As regularly employed maintenance men are paid their necessary expenses in the field in addition to their salary provision is necessary for such items as are chargeable to the particular section and road.

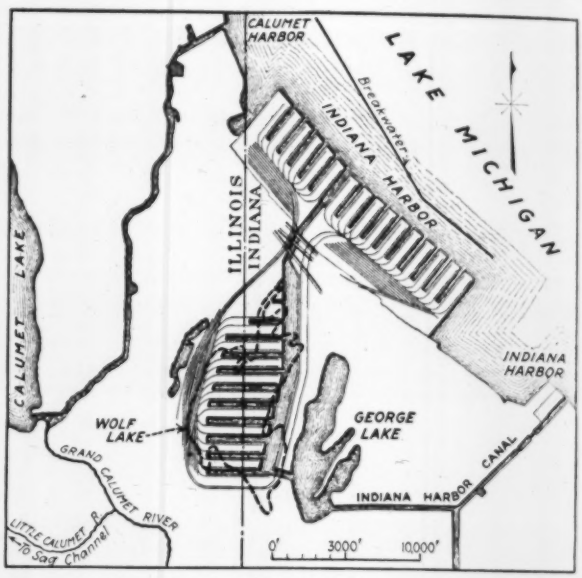
These reports are bound in triplicate in bank-book binding, the blanks being in three different colors. The first, or white, sheet, being the original, is sent to the district engineer by the maintenance foreman, who signs it, and then is sent to the head office for information and record of costs. The second, or yellow, sheet is retained in the district engineer's office for his files. The first and second sheets are perforated and the third, or pink, sheet is not perforated and remains in the book for the maintenance foreman's record and for reference at any time.

New Location Proposed for Chicago Harbor by Army Engineers

A NEW harbor site for the port of Chicago, utilizing an unoccupied part of the lake front at the Illinois-Indiana boundary line, south of the Calumet River and including the development of Wolf Lake, is proposed by Col. W. V. Judson, Corps of Engineers, U. S. A., who is the U. S. district engineer stationed at Chicago. He suggests the name "Illiana" for this new harbor, which is shown in the accompany plan. In view of the probable opening up of an 8-ft. barge channel to the Mississippi River and a 22 to 25-ft. ship channel through the Great Lakes and the St. Lawrence to the Atlantic Ocean, together with the fact that Chicago is a great railway center, Col. Judson believes that great port facilities will be needed to provide for vast transfer and warehousing operations in the Chicago district.

In this district the lake front is already occupied largely by residential, park and industrial developments, and the two harbor sites reserved north and south of the mouth of the Chicago River are considered much too small for the accommodation needed. The Chicago River has become unfit for navigation by large vessels, in Col. Judson's opinion; its commerce is now only 20 per cent of what it used to be and places indirect costs upon the community by bridge operations and interruptions to land traffic. Lake Calumet has been proposed for a harbor site, but has the disadvantage of being accessible only by the winding channel of the Calumet River, which is crossed by numerous bridges.

A little further east, however, are Wolf Lake and George Lake, lying close to the shore of Lake Michigan, which has here an unoccupied front of about 3½ miles. In and around the two lakes is an undeveloped area of six square miles of submerged and marsh lands. The



PROPOSED HARBOR FOR CHICAGO

tentative layout for the new harbor, as shown, provides nearly four miles of berthing for vessels and track storage for about 30,000 cars. These general plans have been approved by the War Department. Numerous railways near the site provide ample traffic connection and a short canal would connect the harbor with the Little Calumet River, which with the Calumet-Sag drainage channel forms a branch of the barge waterway from Chicago to the Mississippi River. The piers are planned to be 750 ft. wide, with provision for warehouses, tracks and driveways; those on the lake front are about 3,000 ft. long and those on Wolf Lake about 4,100 ft. long.

Col. Judson points out that the Esch-Cummins bill places upon the War Department the duty of studying local harbor conditions and giving advice as to developments suitable to commercial needs. After several years of study of the Chicago district he considers that the proposed site and development offer the best opportunity for providing adequate facilities for the future.

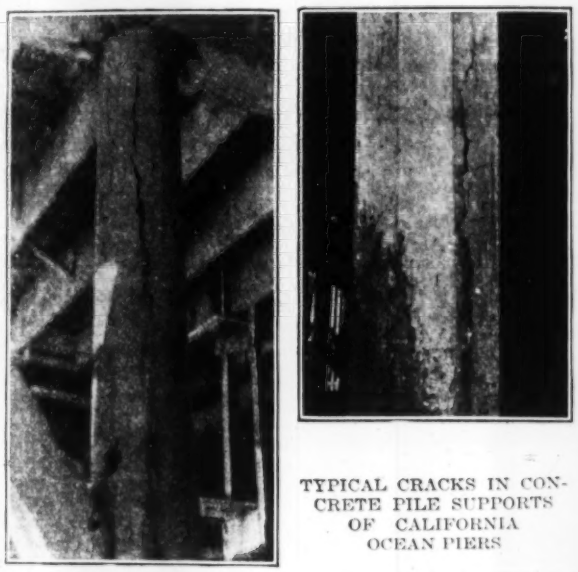
Elimination of Delays in Railway Traffic

Measures for relief from the present congestion of railway traffic by eliminating delays to trains have been recommended by the American Train Dispatchers' Association as follows: (1) Construction of double track from all large terminals to the first passing track, thus facilitating the movement of trains in and out of terminals; (2) universal adoption of the "19" train order system permitting trains to receive orders without stopping, which system is in use on several trunk lines and the safety and economy of which have been demonstrated; (3) reduction in train tonnage where necessary to permit trains to maintain a reasonable average speed and thus avoid loss of power by tying up engines and crews short of terminal points in order not to violate laws as to time of service; (4) closer inspection of trains at terminals to avoid the occurrence of delays due to hot boxes and other defects on the road; (4) more general installation of automatic block signals to facilitate more rapid line movement.

More Observations of Effect of Sea Water on Concrete

Ocean Piers in Southern California Are All Fast Disintegrating—Piles in Boston Harbor Eleven Years Old

THE behavior of concrete in seawater is being made the subject of study in many quarters and in consequence there is being built up bit by bit a practice of design for marine structures in which concrete is used. As a contribution to this study there is given here the results of some recent observations on a number of concrete piers extending into the Pacific in southern California and a report on the condition in 1920 of the test piles placed by the Aberthaw Construction Co. in Boston Harbor eleven years ago.



TYPICAL CRACKS IN CONCRETE PILE SUPPORTS OF CALIFORNIA OCEAN PIERS

The shore of the Pacific, north, west, and south of Los Angeles, Cal., is lined with a succession of towns and small cities, in nearly every one of which there is at least one pleasure pier extending well into the ocean. Most of these piers are of concrete and the design, though by different engineers, has become more or less standardized. The typical pier is of precast reinforced-concrete piles, square, round or hexagonal, driven in transverse rows 10 to 12 ft. apart and carrying, as a rule, the wooden floor on wooden floor-beams resting on the piles, though in some cases the entire structure is reinforced concrete, with the floor integral with the piles. A distinguishing feature is that the piles or posts are all slender, ranging from 10 to 24 in. diameter, and that their unbraced height is exceptionally great. In some cases at the outer end the floor will be 30 ft. above water level and the water depth 20 ft. more, so that the unbraced length of the concrete pile will be 50 ft. In few of the dozen or more piers is there any transverse bracing.

Early in December, 1920, all of these piers from Santa Monica on the north, to Huntington on the south, were examined. The inspection covered piers at the places named and at Venice, Manhattan Beach, Hermosa Beach, Ocean Park, Redondo Beach, Long Beach and Seal Point. At the same time a casual inspection of the Los Angeles municipal pier at San Pedro was made but the harbor there is so filled with oil that all structures are covered with a thick scum which prevents any close examination of the concrete, except to note that there is no pronounced disintegration. This oil coating probably acts as a protection against seawater action, a condition also noted below in the Boston tests.

The condition of the piers is deplorable. With the exception of one completed only last summer, deterioration is marked and varies approximately as the age of the structure. In fact, it is almost possible to tell the age of the pier by the extent of the cracking. The failure is typical. In the most recent piers, there are to be found on practically every pile or post thin vertical cracks following approximately the probable line of the reinforcement and extending from low to high-water. Rarely does it drop down as low as the low-water mark or rise much above the high-water mark. With age these cracks increase in size; rust stains begin to appear and the concrete to scale off from the bursting pressure of expanding reinforcement. Whole slabs of concrete will be found missing occasionally and the exposed steel rapidly disintegrating, and in structures where this has occurred the number of piles affected is larger than in the newer piers. The final stage is the complete failure of the pier as in the municipal pier at Santa Monica, the collapse of which was described in *Engineering News-Record*, March 25, 1920, p. 621, and which is now being replaced by a creosote pile structure.

Most of these piers, as has been noted, have wood floor systems so that the deterioration is confined to the supporting piles but in some of them, notably the V-shaped pier at Redondo Beach, reinforced-concrete floor systems are used. At such places the under side of the floor generally shows signs of deterioration. Rust marks indicate clearly the location of reinforcement, if that steel has not already broken through the cracked concrete. Such floors are of course well above the seawater itself, although wet by spray and splash.

The deterioration is confined practically entirely to cracking, either obviously or presumably, over the reinforcement. That is to say, scaling of face concrete is not at all conspicuous although there are some evidences of it. As a rule, however, the condition of slabs on sea walls and of bulkhead walls apparently of mass concrete, or at least of concrete only lightly reinforced, is good. On the piles themselves corner scaling, in the case of square or hexagonal sections, is not especially notable, nor is there any pronounced deterioration of the face concrete. Cracks are without doubt over the steel.

No attempt was made to trace the history or learn the precise design of the structures. They vary in age from one to eleven years (the latter being the Santa Monica pier which has failed) and they were built by different people, under the design of different engineers. It is probable that there was little in common in the methods used, though the chances are that the materials used are the same. The concrete with hardly an exception is what would be called good; that is, it is superficially dense, smooth and hard, with no evidence of porosity. It is just the kind of concrete that would satisfy an inspector or which would be pointed to with pride by a builder. Any trouble with the concrete itself lies much deeper than can be determined by ordinary methods of inspection.

The depth of the steel cannot be determined accurately in every case, but all evidence points to a covering generally of less than 2 in. and in some of the badly cracked piles the steel will be found at a depth less than

TABLE I. CONCRETE TEST PIECES IN SEA WATER IN BOSTON HARBOR AND CONDITION IN 1912

(Pieces 16 x 16 in. x 16 ft. Placed Feb. and March, 1909, by Aberthaw Construction Co., Boston, Mass.)

No.	Cement	Mixture	Amount Water	Remarks	Condition—Oct. 31, 1912
1	Normal portland	1 : 1 : 2	Dry		Back and sides in good condition. Face porous and eroded.
2	Normal portland	1 : 1 : 2	Wet		Good condition.
3	Normal portland	1 : 1 : 2	Very wet		Back and face slightly eroded; otherwise good condition.
4	Normal portland	1 : 2½ : 4½	Dry		Face badly eroded entire length, most at mid-tide. Back and sides good as when placed, but poorly spaded.
5	Normal portland	1 : 2½ : 4½	Wet		Good condition.
6	Normal portland	1 : 2½ : 4½	Very wet		Good condition; edges at low tide slightly worn.
7	Normal portland	1 : 3 : 6	Dry		Very poor condition. Portions entirely submerged and entirely out of water in good condition, but portion affected by tide badly eroded to maximum depth of 9 in.
8	Normal portland	1 : 3 : 6	Wet		Face and sides good. Back eroded in mid-tide section, depth 4 in.
9	Normal portland	1 : 3 : 6	Very wet		Good condition.
10	No iron in cement	1 : 1 : 2	Wet		Good condition.
11	No iron in cement	1 : 3 : 6	Wet		Good condition.
12	High alumina cement	1 : 1 : 2	Wet		Good condition.
13	High alumina cement	1 : 3 : 6	Wet		Back slightly flaked at low tide, mid-tide edges eroded
14	Low alumina cement	1 : 1 : 2	Wet		Good condition.
15	Low alumina cement	1 : 3 : 6	Wet		Back slightly flaked at low tide.
16	Iron ore cement	1 : 1 : 2	Wet		Good condition.
17	Iron ore cement	1 : 3 : 6	Wet		Slightly scaled on all sides, 3 ft. above low water
18	Slag portland cement	1 : 1 : 2	Wet		Back slightly flaked at high tide for 3 ft.
19	Slag portland cement	1 : 3 : 6	Wet		Back badly eroded below high water mark, depth 3 in. Face and sides slightly eroded at low tide. Back very soft. Edges eroded below high water.
20	Normal portland	1 : 3 : 6	Wet	Extra mixing	Four sides slightly eroded at low tide.
21	Normal portland	1 : 3 : 6	Wet	Sea water used	Lost.
22	Normal portland	1 : 3 : 6	Wet	Add 10% hyd. lime.....	Edges badly eroded at mid-tide, depth 4 in., length 2 ft. Low-water faces slightly eroded.
23	Normal portland	1 : 3 : 6	Wet	Add soap and alum	Edges badly eroded at low tide, depth 3 in., length 4 ft. Edges on front face slightly eroded for whole length.
24	Normal portland	1 : 3 : 6	Wet	Add 5% colloidal clay	Edges slightly eroded, otherwise good.

half that. But while the deterioration is more rapid and intense where the covering is light, there is evidence that the penetration of the corrosive salts can go much deeper than 2 in. at times, though the relation between the depth of penetration and quality of concrete is not well established. It is noteworthy that all along this shore well-made lamp posts of dense good concrete consistently show cracks, though the steel be well embedded and the post far back from the water itself.

The examination of these piers is a revelation as to what will happen to what may be called good journeyman concrete in seawater in a warm climate, for of course it never drops anywhere near freezing here. There are a dozen or more piers in this 30-mile stretch, costing well over a million dollars, and unless all present indications are wrong the whole lot will have to be replaced in ten years, just as the Santa Monica pier is now being replaced. In fact at least one of the piers is now in a dangerous condition and should be closed to the public. The failure is progressive and certain, for once the fine hair crack appears over the steel, the final result is as inevitable as a chemical reaction. With the high unbraced bents common to these piers it is probable too, that excessive vibration is set up in heavy weather which serves to hasten the separation of concrete and steel at the cracks.

Tests in Boston Harbor

The concrete test-pieces recently examined in Boston Harbor were placed there in February, 1920, as a part of an investigation into the effect of seawater on concrete, particularly in a freezing climate. The specimens were in the shape of square piles, 16 x 16 in. section and 16 ft. long, which were hung under the cap piece of a wharf in Charlestown Navy Yard, in such a position that the bottom would always be immersed while the top would always be above high water. Twenty-four specimens were made, using different kinds of cement, consistency and proportions. Reinforcement, in the way of two ⅝-in. twisted bars with a heavy embedment was added to strengthen the pieces in handling.

The pieces have been examined in 1910, 1912 and finally in June, 1920. The earlier examinations were reported in *Engineering Record*, Aug. 19, 1911, and *Engineering News*, Nov. 20, 1913. The latest inspection is covered most thoroughly in a booklet just issued by the Aberthaw Construction Co., from which the data given herewith is taken.

TABLE II. CONDITION OF BOSTON HARBOR TEST PIECES IN JUNE, 1920

Specimen	Condition June 9, 1920
1	Eroded no worse than 1913. Broke when placed on pier due to weight of one end. Concrete in center badly rotted along cracks which were invisible before specimen broke. Cracks existed for some time.
2	In good condition.
3	Unchanged since 1913. Good condition.
4	Bottom no worse than 1913. Large pits at back corners mid-height. Top half covered with oil.
5	Back at mid-height badly pitted. Otherwise in good condition as 1913.
6	Corners gone mid-height. Bottom sound. Front pitted. Reinforcement exposed mid-height. Fine aggregate rotted about ½ in. in depth mid-height.
7	Entirely gone between high and low water. Top of bottom part badly disintegrated. Fine aggregate rotted to about ½ in. in depth below high water.
8	Same condition 1913. Back badly gone 3 ft. from bottom to 3 ft. from top. Steel exposed in back face. One bad hole about mid-height half way through. Another about three-quarters.
9	Front corners badly eaten between high and low water.
10	As good as 1913. Concrete solid.
11	Large hole in front face nearly half way through between high and low tide. Concrete worse at about high water.
12	Corners broken slightly. Face is slightly pitted about mid-height. Bottom and top good.
13	Badly eaten between high and low water. Concrete very rotten at depth of 1 to 2 in. in middle. Corners could be broken off in large chunks.
14	Good condition.
15	Pitted at low water on face and sides. Outer concrete of forners rotted ½ in. in depth. Fairly good condition.
16	Good all over. Corners very sharp.
17	Badly pitted on faces between high and low water. Coarse aggregate exposed. Concrete fairly solid.
18	Good on face and sides, back slightly pitted. Concrete sound.
19	Specimen missing.
20	Pitted on all faces from high tide to bottom. Corners badly gone. Back corners badly pitted but not gone.
21	Lost.
22	Entirely gone in middle, about 4 ft. at top, 6 ft. at bottom remaining. What remains badly rotted.
23	Concrete between high and low water badly rotted. Less than half of original area of specimen remains between high and low water.
24	Face, side and back pitted between high and low water. Back corners badly eaten.

Table I shows the variation in composition of the specimens and gives a brief statement of their condition in 1912. The 1920 condition is given in Table II.

In the opinion of the engineers who examined the specimens the crude oil coating of the piles has something to do with their present condition. The increasing use of crude oil in and around the Charlestown Navy Yard has resulted in a great deal of it floating on the surface of the water. This, moreover, appears to have deposited on every one of the test specimens a coating of tar-like material varying from more than ¼ in. thick at the top to practically nothing at low water. This coating was found to be even more tenacious than ordinary tar and practically impossible to remove without the use

of gasoline or some other similar liquid. The engineers think that under present conditions very little seawater touches these specimens and the coating would make them almost permanent. It was noticed in the earlier inspections that there was a large number of barnacles covering all surfaces of the specimens. At the time they were inspected in 1920, however, there were no barnacles between high and low water, very few mussels below low water and a considerable amount of marine growth resembling jelly fish adhering to the specimens under water. Apparently the oil destroys all marine growth with which it comes in contact.

Study of the table and of the views of the specimens does not offer any definite reason as to causes of deterioration. The report itself says "While at this time it seems hardly advisable to offer an opinion as to the comparative quality of the various specimens, or even to imply that these test piers have, as yet, definitely proved any action or non-action of seawater, it seems reasonable to call attention to the fact that specimens 2, 3, 4, 16 and 18 show little or no effect from their twelve years' immersion." It will be noted that all of these specimens are of a 1:1:2 mix and were mixed "wet" or "very wet." Apparently, too, specimens 1, 7, 11, 13, 22 and 23 are in the worst condition. These are all 1:3:6 "wet" mixers, except No. 1, which is 1:1:2 "dry." Variations in cement or special additions seem not to have had any effect.

Unusual Trestle Filling Methods on the Soo Line

Dumping from Side and Main Trestles—Base Spread by Hydraulic Sluicing—Fill Material Rehandling by Steam Shovel

IN RECENT work of filling old timber trestles on the Minneapolis, St. Paul & Sault Ste. Marie Ry. the contractors have included combinations of hydraulic sluicing and dumping from both main and temporary tracks in order to meet local conditions.

Blackhoof Trestle—At Blackhoof, Minn., the railway crosses the Blackhoof River on a 500-ft. trestle 80 ft. high, with an approach 700 ft. long and 25 ft. high. The bents are of framed timber, set on a pile foundation and spaced 15 ft. c. to c. A 30-ft. steel span carries the track over the main river channel, but previous to the filling a 24-ft. concrete arch culvert 220 ft. long was built to take care of the river. To give clearance for the construction of this culvert, three trestle bents were removed and replaced by a timber deck truss span, as shown in Fig. 1.

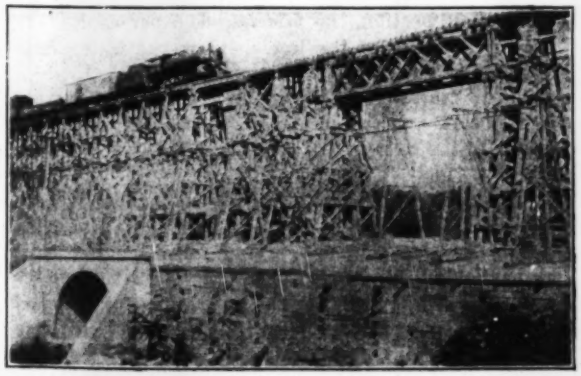


FIG. 1. BASE OF FILL SPREAD BY WATER JETS CARRIES DUMPING TRESTLES

FIG. 2. ONE OF THE SIDE DUMPS FOR FILLING (MAIN LINE TRESTLE AT THE LEFT)

As no suitable filling material was to be had in the vicinity, the railway company hauled sand by work trains from its Moose Lake pit, about twelve miles distant. The slopes of the hills on either side of the river are very steep and the soil is a soapy red clay, making a treacherous foundation on which to place a fill. To put in the base of the embankment without endangering the concrete culvert or moving the bents of the bridge out of alignment, it was decided to spread the dumped material by sluicing, as river water was available and the filling material would flow readily. Two steam duplex pumps with 6-in. suction and 4-in. discharge were installed on the upstream side, the water being delivered through two 2½-in. hose lines with 1½-in. nozzles.

Cribs of old bridge ties were built on both sides in line with the headwalls of the culvert to hold the material, frequent openings being left in the cribs to allow the water to run off. These openings were blocked as the sand was filled up to them. Material was hauled onto the old trestle by work-trains and was plowed off to both sides with a center plow, being deposited on a sand bar between the concrete arch and the old river channel. In the intervals between trains the material was leveled by "washing," so as to maintain a uniform pressure on the culvert and on the bents of the bridge. The base was carried up in this manner to a height of twenty feet.

On this foundation temporary trestles 30 ft. high were constructed, from which the work of filling was continued. In this manner two separate fills were constructed, one on each side of the bridge, each 20 ft. wide on top and located so that the outside slopes would conform with the final slope line of the bridge fill. One of these side fills is shown in Fig. 2. The space between these two embankments and the filling up to the main line grade will be done next season by the railroad company, dumping directly from the top of the bridge. The stringers will not be removed until the season of 1922, thus allowing time for settlement of the fill.

Material for making the two side embankments was delivered at the bridge approach by the work trains, being plowed off to form a stock pile, from which a steam shovel loaded 1½-yd. dump cars of 24-in. gage, as shown in Fig. 3. Two ten-car trains were used, each hauled by an 8-ton steam locomotive. An under-crossing was provided by skewing two bents of the trestle, this allowing material to be hauled entirely from one side of the approach. About 90,000 cu.yd. of filling have been placed during the past season.

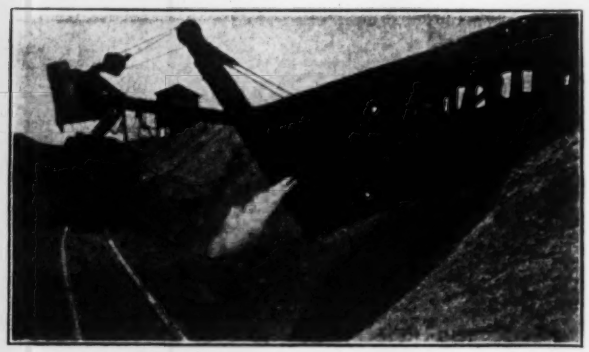


FIG. 3. STEAM SHOVEL LOADS DUMPED MATERIAL

Beverly Trestle—At Beverly, Wis., a trestle 1,200 ft. long and 40 ft. high, with frame bents on pile foundations, carried the line across a muskeg or marsh bottom. Drilling tests indicated that hard bottom existed at 10 to 40 ft. below the surface. Material for the fill was obtained by widening a cut at one end of the bridge, borrowing on one side of the track only. This material varied from sand and clay to deposits of large boulders.

A pile trestle was built on each side of the bridge, just inside the prism of the new fill, these trestles being 20 ft. high, with pile penetration of 15 to 40 ft. The material was loaded by a steam shovel into 2-yd. dump cars of 24-in. gage. Three trains of fourteen cars each, with 10-ton steam locomotives, were employed. As the borrow pit was at the elevation of the main line, there was a 3 per cent grade down to the dumping trestle. Bents in the bridge were skewed to allow a construction track to pass through. Material was dumped from both trestles to maintain a uniform pressure.

In order to prevent the bridge from being raised by the settlement of these two side fills, material was dumped also from the main track on the bridge. The timber guard rails were removed and a rail was laid outside of each main line rail to form a 24-in. track on each side of the bridge. A movable rail section provided a crossing of the main-line rail. From these two narrow-gage tracks material was dumped outside the bridge on both sides and into the center, alternate bridge ties being removed to permit of dumping between the main track rails. With this system of tracks, material could be deposited wherever necessary to prevent crowding caused by unequal settlement. The trestle has been filled to the top, a total of about 150,000 cu.yd. being dumped, but owing to the continued settlement of the embankment it will be necessary for the railroad company to do some additional finishing next season. The stringers will not be removed before final settlement.

Morris & Dougherty, St. Paul, Minn., had the contract for filling both these trestles, the work being under the direction of J. E. Finley as their engineer. E. A. Whitman is chief engineer of the Minneapolis, St. Paul & Sault Ste. Marie Ry.; the assistant engineers in charge were W. H. Stedje at the Blackhoof bridge and D. McIntosh at the Beverly bridge.

Commercial Association and Engineering

More than one-third of the 70 activities of the Denver Civic and Commercial Association listed as accomplishments in 1920 in the *Denver Commercial* relate to engineering or is of vital interest to engineers. The association has an engineering section.

Leakage from Machine Banded Wood Pipe

By J. L. Campbell
Chief Engineer, El Paso & Southwestern Ry.

IN DISCUSSING the relative merits of cast-iron and wood pipes J. W. Ledoux, in *Engineering News-Record*, Nov. 11, 1920, p. 932, says of leakage from wood pipes: "Under very favorable conditions it may be possible to obtain results where the leakage will not be greater than 500 gal. per inch of diameter per day per mile. With the best form of joint, pipe and quality of wood a very tight pipe can sometimes be secured."

Some twelve years ago a pipe line 140 miles long, of which 110 miles are machine-banded wood pipe, was built for the El Paso & Southwestern R.R. The construction of this pipe was under my direction, as has been its maintenance to date. Recently, I had made a test of leakage from this wood pipe on two sections, consisting of unbroken hourly weir measurements day and night for one week of the water delivered into and from the pipe. On the first section, the pressure varied from 1 to 125 lb. with a mean pressure of about 75 lb. On the second section pressures were 1, 125 and 55 lb.

The first section consisted of 11.5 miles of pipe, of which 51 per cent is 21, 28 per cent is 16 and 21 per cent is 10 in. in diameter, equal to a mean equated diameter of 17.29 in. The 21-in. and 5,000 ft. of the 16-in. pipe have cast-iron collars; 5,000 ft. of the 16-in. has wood collars and the balance of the pipe has mortise and tenon joints. The interior diameter of the iron collars is ¼-in. less than the exterior diameter of the spigot on the end of the pipe, making a tight driving fit.

On this section, the mean daily leagage was 3,000 gal. equal to 15 gal. per inch of mean diameter per mile per day. There was no measurable leakage from the pipes having the iron collars. These collars and the pipe on which they were placed were made of superior material under our specifications and inspection.

The second section of conduit consisted of 28.15 miles of pipe, of which 12.1 per cent is 14 in.; 7.8 per cent is 13, 10.4 per cent is 12; 25.4 per cent is 11; 3.2 per cent is 10; 20.7 per cent is 7.5 and 20.4 per cent is 5 in. in diameter, equal to a mean equated diameter of 9.64 in. The 14-, 13- and 4,800 ft. of the 11-in. pipe have wood collars. The balance has mortise and tenon joints.

On this section, the mean daily leakage was 71,000 gal., equal to 262 gal. per inch of mean diameter per mile per day. There was no material leakage from the pipe having the wood collars.

On the first section, the total loss by leakage was 0.20 per cent of the total water delivered into the pipe. On the second section, the loss was 6.35 per cent.

The first section of the line delivers the water from the source of supply in the mountains 8,000 ft. above sea level to a storage reservoir on the adjacent plateau 1,000 ft. below and the second section delivers from the reservoir to the railway in the valley 1,700 ft. lower than the reservoir.

My experience leads me to the conclusion that if wood pipe is satisfactory in the matter of leakage, its design, materials, construction and laying must be first class in all particulars. When so made and laid, it should be substantially water tight for the conditions for which it is properly designed, especially if it has good cast-iron collars for the joints. A good wood collar will keep the leakage within satisfactory limitations. All our wood pipe is now made under our own specifications.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

For the Use of the Personal Pronoun

Sir—I was taught in school that a letter should never commence with the word "I." I was also taught that to use the word "I" frequently during a letter indicated a certain amount of conceit on the user's part. I observe that the writers of the letters in your columns almost invariably abstain from the use of this word.

I wish to protest against this ridiculous custom. The only substitute for the offensive word "I" is the cumbersome expression "the writer" which is eight letters and a space longer. In these days of conservation and of high efficiency it is needless to emphasize the economic loss caused by this false modesty.

On p. 805 of your issue of Oct. 21, 1920, there are two letters dealing with the same subject in which the expressions "the writer" and "the author" simply confuse the reader as to what the letter writers are talking about. I tried to read them but my feeble brain could not keep track of the persons indicated by these expressions.

By the same token I would like to see the authors of your technical papers say "I think this" or "I believe that" instead of "the writer thinks," or "the writer believes," or "it is believed." If they did this the reader would never be in any doubt as to whose thoughts or whose beliefs were being put forward.

C. T. BRADY, JR.,
Resident Engineer, U. S. Steel Products Co.
Buenos Aires, Argentina, Nov. 20, 1920.

Gillette's "Earthwork and Its Cost"

Sir—Mr. Hammond's review of Gillette's "Earthwork and Its Cost" in *Engineering News-Record*, Sept. 16, 1920, p. 567, and Mr. Gillette's comments on the review, Nov. 18, 1920, p. 1001, open up a subject which merits additional discussion.

It is probable that if statistics could be assembled on the subject it would be found that much more harm comes from the lack of published cost data than from the misuse of what little is published. It is not customary for a contractor to allow an inexperienced man to prepare an important bid with the aid of a handbook. If the contractor keeps intelligible cost records of his own, they are used; if not, a more or less accurate guess is made, but the figuring or the guessing is always done by the most competent men in the organization. Sometimes these men hold stubbornly to ideas which are the result of their own experience, scorning the aid of a handbook which might give them valuable assistance. In any event the danger of the office boy wrecking the concern by the careless use of a handbook is very remote.

The span of a human lifetime is so short that one man can personally gather only a very small portion of the technical data which he must use in his work; this applies to cost data as well as to all other technical information. We must depend for a large part of our ideas on the experiences of others as we find them recorded on printed pages. As a man increases in experience he becomes more competent to intelligently interpret and use the results of others' experience, which ability is of vastly more value to him than his notebook record of his own personal experience.

It seems that the importance of cost data is not properly emphasized in our colleges. This is partly due to a feeling on the part of the professor that any cost figures he may give the student will be out of date and useless by the time the student is ready to use them, and partly because the professor very rarely has cost data in his possession. The result is that the subject is touched on very lightly and the young man goes to his first job with an exaggerated idea of the relative importance of pure technical knowledge as compared to a knowledge of costs and methods of doing work, and it is usually several years before he gets the proper sense of proportion.

Practically all decisions on questions of engineering design and construction, from the smallest detail of design to the question of the feasibility of a large project, are, in the final analysis, based on cost.

Most engineers need more knowledge of costs. We have no right to ask contractors, manufacturers, or railroad companies to publish the intimate details of their business, but we should have more cost data published on public works.

If anyone wants to publish reliable cost data let us not discourage him. CHARLES P. DUNN.

Seattle, Wash., Dec. 30, 1920.

A Few Lapses in Textbooks

BY R. FLEMING,
American Bridge Co., New York City

The writer has had the mortifying experience of having his attention called to errors on the printed page where he had given especial attention to the manuscript and had read the proof. If errors are found in articles of a few columns in length, is it surprising that they occur in textbooks of a few hundred pages? No author can claim infallibility. With the greatest care on his part some one is liable to find an occasional error or a statement expressed so that it may mislead. A few "lapses," to use a borrowed term, in leading textbooks will be cited.

Burr, in "The Elasticity and Resistance of the Materials of Engineering," gives formulas for the deflection of beams due to shearing stress. The deflections found by these formulas are but a small fraction of those obtained by other writers. Burr errs in introducing the Moment of Inertia of the beam into his formulas. The usual method of considering the shearing deflection to be the same as that of a beam of rectangular cross section with depth and breadth equal to depth and thickness of the web is much more nearly correct.

In Heller's "Stresses in Structures" under "Columns in Towers" we read: "The bracing in the vertical planes holds the columns against buckling in two directions

only. To prevent buckling in a diagonal direction the horizontal braces *AC* and *BD* may be used." There can be no buckling in the direction of horizontal diagonals from wind forces. This is readily seen by passing a horizontal plane through a 4-post tower at a panel point. Each corner is held in place by the bracing in the adjoining vertical planes. To distort these corners in a diagonal direction the diagonal rods in the vertical planes must become longer, and this is impossible without stretching them beyond their elastic limit.

In this connection it may be noted that an adequate treatment of wind bracing in water towers is lacking in our textbooks. It is usually stated that wind stresses in a post are maximum when the wind is blowing in the direction of a diagonal passing through that post and the center of the tower. Attention, however, is not called to the side bracing, unless it is to special cases. In 3- and 6-post towers, wind stresses in side bracing are maximum when the wind is blowing in the same direction as for maximum post stress, but in 4- and 8-post towers the wind stresses in the members, exclusive of posts, of any side are a maximum when the wind is blowing in a direction parallel to that side.

Another subject needing fuller treatment in many textbooks and a more consistent treatment in others is that of initial tension. Merriman and Jacoby in "Roofs and Bridges, Part I" are in error when they state that if the wind tension in a diagonal of the lateral system is less than twice the initial tension, the maximum stress equals the initial tension. In accordance with their own presentation of the subject, the maximum tension in such cases is equal to the initial tension plus one-half the tension due to wind.

A paper in the "Second Annual Report of the National Advisory Committee for Aëronautics" (Washington, 1917), begins: "Ten years ago there was only one laboratory in France in which researches on the resistance of air were carried on in a systematic manner. . . . At this epoch they were still teaching in certain engineering schools, regarding the resistance of air upon planes inclined to the direction of the wind, the law of the square of the angle of incidence, although it had long been demonstrated that this law, applied to the flight of birds, led to absurd conclusions." Some textbooks, Spofford's "Theory of Structures" among others, still follow the teaching thus condemned.

A striking illustration of the difference between theory and practice is found in Johnson, Bryan and Turneaure's "Modern Framed Structures, Part III, Design." Appendix C gives a clear exposition of oblique bending moments as determined by the use of the S-polygon, and in Chapter XI this method is applied to the design of purlins for sloping roofs. As a result the author finds that for trusses 15 ft. apart, a slope of 6 in. to the foot and covering of No. 20 gage corrugated sheet metal, the purlins should be 8-in. I-beams, spaced 4.1 ft. apart. In practice 6-in. channels are used with tie rods extending from purlin to purlin and over the ridge of the roof. In an acquaintance with more than a thousand roofs the writer does not know of 8-in. I-beams being used for purlins under corrugated sheet metal where trusses are less than 20 ft. apart. Writers of textbooks give scant mention or neglect altogether the use of tie rods for connecting purlins of roofs.

Another instance where theory and practice are not in accord is in the specifications for steel frame buildings given by Professor Ketchum in his textbooks. He specifies, "No metal of less thickness than ¼-in. shall be used except for fillers." If this provision were followed the most commonly rolled channels under 12 in. and beams under 7 in. would be prohibited on account of their web thicknesses being less than ¼ in. The writer suggests the following clause be used instead:

"No steel in any structural member subject to stress shall be less than ¼ in. thick, except the webs of rolled beams and channels. Steel subject to the action of harmful gases or severe atmospheric conditions shall be not less than ⅜ in. thick."

Many textbooks and handbooks give empiric formulas for the weight of steel roof trusses. As the writer has pointed out (*Engineering News-Record*, March 20, 1919, p. 576) these formulas are of little value. Some are greatly misleading. It is a sign of progress that in the 21st edition of the Carnegie "Pocket Companion" the absurd formula for the weight of roof trusses found in previous editions is omitted and none given to take its place.

Typographical errors are probably more annoying to the busy engineer than any others. A plus sign given instead of the multiplication sign, the decimal point misplaced, the parenthesis marks omitted, an "l" used instead of "/," or vice versa, all lead to wrong conclusions. Such errors can be avoided only by vigilant and repeated proofreading.

In conclusion, the writer acknowledges an obligation to each of the books mentioned. He has them all close at hand, and again and again have difficulties been cleared up by their help. In truth,

"Errors like straws upon the surface flow,
He that would search for pearls must dive below."

White Lead in Paint

REVIEWED BY A. W. CARPENTER
Assistant Valuation Engineer, the New York Central Railroad Co.

WHITE-LEAD: Its Use in Paint. By Alvah Horton Sabin, M. S., D.Sc., Author of "Technology of Paint and Varnish," "Red-Lead," etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall Ltd. Cloth; 5 x 7 in.; pp. 133. $1.25.

An interesting and useful little book written by a real authority on the subject is this work by Prof. Sabin. It shows a thorough belief in the superiority of the basic carbonate white lead over all other white paint pigments and presents that belief in a convincing and readable manner.

The author states that the book is "for the instruction and guidance of those whose need and use of this material [white lead] prompts them to seek knowledge about it of a simple but reliable sort rather than for the chemist and scientific expert." It certainly seems to attain this object.

Historical references to the manufacture and use of white lead are interesting and entertaining. Modern processes of manufacture of the material and the peculiar properties resulting from the different processes are described. Other white pigments—including zinc oxide, basic lead sulphate, lithopone, leaded zincs and auxiliary pigments (frequently termed inert pigments)—are described in turn more or less fully, with their characteristics as paint pigments.

Prof. Sabin is an advocate of basic carbonate white lead as the sole base pigment for house paints and does not admit any improvement, nor equality at reduced cost, by admixtures of white zinc, lead sulphate or inerts. He gives formulas for priming and succeeding coats for exterior and interior woodwork, new and repainting, and for plaster walls in gloss, egg-shell and flat

finish for interior work, always using the basic carbonate white lead as the sole pigment material with linseed oil, turpentine and drier for the vehicle (except in third-coat flat finish work where the linseed oil is replaced by a small proportion of varnish). He tells how one should proceed to mix and tint paint by hand after these formulas, and how the paint should be applied, what brushes are used and how they should be cared for, and other useful and essential information, together with scientific explanation. Ready-mixed paints are treated in a discussion which shows their merits and defects and points out the greater opportunity for profit in selling inferior mixtures.

A feature of Prof. Sabin's paint formulas is the liberal proportion of turpentine in those recommended for the priming, first and second coats. It is rather to be regretted that nothing is said of the possibilities of single-coat work in repainting, which in these days of high cost is well worth considering and can be successfully practiced, according to the reviewer's experience.

A unique and useful feature of the book is a sheet of tabulations showing the various formulas and the costs of the ingredients thereof, from which the cost per gallon of the combined materials in the resultant paints can be readily derived from varying market prices of the component ingredients. The table also shows the amount of paint produced by each formula and the area in square feet that it will cover in spreading.

The book is to be recommended to the user of paint for wooden and plaster surfaces, either amateur or professional, and to others interested in paint technology and painting practice.

Planning for Minimum Service Cost

Reviewed by HARRY BARKER
of Horton, Barker & Wheeler, Engineers, Albany, N. Y.

FINANCIAL ENGINEERING: A Text for Consulting, Managing and Designing Engineers and for Students—By O. B. Goldman, Consulting Engineer, Professor of Heat Engineering, the Oregon State Agricultural College, etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 271; illustrated. $3.50.

The more an engineer practices, the smaller becomes the proportion of cases where only one construction, layout, or procedure is feasible, or where temporary investment limitations dictate the design to the detriment of ultimate economy in service. More and more the problems of a public utility or industrial engineer become the selection of equipment from various available types and the design of works along alternative lines. Alertness is needed in planning to develop required service at a minimum of final expense. Generally speaking, a good grasp of matters of finance, earnings, true expense burdens and cost apportionments have been an attribute of mature years, experience and study, for comparatively little has been published except in scattered and incomplete papers, and knowledge has been passed along slowly in restricted measure from mind to mind in personal contact. Therefore Prof. Goldman's book will be specially welcomed by the younger engineer.

The author's plan in this book is to present certain data, axioms, corollaries and theories, all of which lead to computations illustrating how one scheme or another yields service at the lowest cost. Some readers may feel that he has been so specific and unqualifying in his tables, formulas, and solutions that from what is there given they may pronounce final judgment off hand; but only the veriest amateur would hazard, without making his own studies under his own local conditions, the dictum that (for instance) a high-speed simple engine renders ultimate service at less cost than a simple low-speed engine if the hours of service are more than 461.1 per annum and is in turn displaced by the compound engine at 532.1 hours' use. Few readers will have the temerity to look up from these pages and say that, for a 100-hp., 25-ft. head, centrifugal pumping installation, five 520-hp., 2,300-gal.-per-min. units produce cheaper service than two 50-hp. 4,800-gal. per-min. machines.

It is not extremely material, either, whether the book appears difficult in spots; or whether every reader agrees with every detail of the author's method or exposition. No book in this field can do better than to suggest explorations; each man must secure his own basic data, make his own assumptions, and pursue his own calculations until he is satisfied with his own answer.

The author's method is (1) to find the annual operating cost of a design and to capitalize it, on the assumption that the same service will continue indefinitely, and (2) to capitalize a cost of depreciation by taking the sum of present worths of investments and reinvestments. The sum of these two capitalized amounts yields the equivalent figure for an investment the income from which would pay for the service rendered. This equivalent investment, to which the author gives the name "vestance," is a measure of the comparative desirability of two designs.

The simple comparisons are extended by dividing this hypothetical *equivalent investment* ("vestance") by the hours of effective service per year, to secure a "vestance per hour" from which can readily be found the hours of service for which one design becomes more economical, all things considered, than some alternative. The scheme is extended in another way by dividing the equivalent investment ("vestance") by various service units, such as cubic feet per second of flow capacity for pipes, to locate that rate of service (velocity of flow in the case of pipes) which requires the least investment.

All this discussion fills 70 per cent of the volume. The rest of the book shows a study of cost apportionment with variable hours of service, with load changes and with operating costs fluctuating with the load changes. The author introduces a multitude of tables of approximate pre-war prices and operating data for boilers, engines, pumps, gas producers, dams, canals, hydro-electric plants, gas producers, etc.

The prospective reader should be warned that he may find the early part of the book disconcerting because of a few radical dicta, though these unaccepted precepts do not really interfere with the study of the author's way of analyzing a design. The author, for instance, early says that his "Financial Engineering" does not invade the field of economics. Yet later, speaking of demand and supply, he avers that "even the most elementary study shows that there is no such law." Also on p. 16, in speaking of risk, he says, "this is something evidently not the basis of interest but rather the want and distress of the user."

The author is not in harmony with a large company of engineers when he denies that "depreciation" can include loss of value from dilapidation (wear and tear) but must cover only obsolescence, inadequacy, and uselessness from lack of demand for service. He would place even major replacements of long-lived items in operating expenses, neglecting for the moment the fact that this would distort the annual expenses of certain

years and render precarious the sacrificed investment in equipment whose life is fixed by irreparable delapidation rather than obsolescence and inadequacy. But in arriving at depreciation as a real computation, the author employs a life table in which dilapidation theory evidently determines life as much as obsolescence and inadequacy. Moreover, the author regards depreciation as a "trust fund" solely for renewing property worn out, or crowded out, and denies the findings of economists and eminent jurists that it is a repayment of investment sacrificed in giving service, to be repaid to the investor and by him put back into renewals, or into his pocket if he pleases.

New Edition of Bellasis' Hydraulics

REVIEWED BY ROBERT E. HORTON
of Horton, Barker & Wheeler, Engineers, Albany, N. Y.

HYDRAULICS WITH WORKING TABLES—By E. S. Bellasis, M.Inst.C.E., Recently Superintending Engineer in the Irrigation Branch of the Public Works Department of India, Author of "River and Canal Engineering," "Irrigation Works," etc. Third Edition. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 348; illustrated. 18/- net.

The first edition of this book, published in 1903, was marked by an unusual amount of original matter and concise and piquant descriptions and discussions of hydraulic features of Indian engineering works. The present edition possesses the same characteristics but is rendered somewhat more cosmopolitan by the inclusion of a critical discussion, somewhat after the order of that used by the late Philip A. Morley Parker in his well-known book on "Control of Water," and covering more recent investigations down to the time of going to press, in all countries, particularly in the United States.

The book is essentially a working manual rather than an exhaustive treatise. Details of experiments are rarely given but there are fairly complete tables of coefficients of various kinds, deduced from experiments on weirs or orifices, pipes and channels.

Glancing through the book, there appears to be an unusually small amount of mathematical discussion, but many of the minor formulas and numerical expressions are run in with the text, and formulas are printed in ordinary type, which renders them less conspicuous than in some other books on hydraulics.

Regarding flow in pipes and channels, the author quotes Houk's conclusion that "the Bazin formula is inferior to Kutter's for all types of open channels, and that although the Kutter formula is not ideal, it is the best available." The author accepts this conclusion. He also takes the position that for practical purposes it is preferable to retain the Chezy type of formula with the exponents of r and s each $\frac{1}{2}$, rather than to attempt to modify this formula by the use of other exponents in such a manner as to render the coefficient constant. However, he gives various other formulas, including that of Manning, and adapts the Manning formula to this viewpoint by expressing the coefficients therefor as a function of r with exponent $\frac{1}{6}$.

Extensive tables of values of coefficients for use in the Bazin and Kutter formulas, particularly the latter, are given, and also a table of the values of the coefficient c in the Chezy formula derived from Manning's formula. These tables afford a ready basis of comparison of the results to be obtained by the Manning and Kutter formulas for a given channel and value of n, and will be found very convenient to that numerous class of engineers which is in the position of making a transition from general use of the Kutter formula to the use of the Manning formula in their practice.

Forty-one pages are devoted to a discussion of variable flow, following generally the lines of discussion of this subject in the early editions of the book. In this discussion, the author attacks backwater problems by methods which are original and enlightening.

Other features of hydraulic practice receiving special consideration are the silting of irrigation channels and the design of non-silting channels. Considerable attention is devoted to hydraulic observations by means of floats, current meters, and other devices. The section on meters is based mostly on European practice.

A subject of great importance on which literature is exceedingly meager is that of unsteady flow in open channels. The problem of the downstream advance of changing stage in a river channel, when the gates of an upstream reservoir are opened or closed, is discussed in a section covering six pages. This discussion is clear and illuminating, but not based on experiments and is essentially hypothetical. It does not go far enough to serve as a reliable guide in practical calculations of the time required for waters from a reservoir to reach a point downstream, for the reason that it does not take into account the occurrence of pressure waves, nor the limiting conditions where the advance takes place in the form of a tidal bore. Experimental data to elucidate this problem are greatly needed.

On the whole, this book is commendable for its lucidity and conciseness. Typographical and numerical errors appear to be unusually rare. It is a book which the practicing engineer will do well to consult before making final decisions in regard to a given problem, if for no other purpose than to obtain the benefit of the new angles of view which it presents on many matters. It is a book which the young engineer seeking to lay the foundation for a broad knowledge of hydraulic practice will do well to read.

[The first edition of the book was reviewed by the late George W. Rafter in *Engineering News*, Aug. 20, 1903.—EDITOR.]

Autobiography of a Leading British Municipal Engineer

REMINISCENCES OF A MUNICIPAL ENGINEER—By H. Percy Boulnois, M. Inst. C. E. London, Eng.: St. Bride's Press, Ltd. Cloth; 6 x 9 in.; pp. 120.

Following his long career as a municipal engineer and an author on related subjects, Mr. Boulnois, by writing the present volume, has won the distinction of being the first city engineer to write an autobiography. Why Mr. Boulnois did this can be best expressed in his own words:

> One of my objects in writing this book was to give to the general public some better conception than they would seem to have at present of the work which devolves on a municipal engineer. Incidentally, its contents may show that such an official can take an interest in literature and in other subjects outside the scope of his daily duties. I am not aware that any other engineer has ever been sufficiently venturesome to write his life, and in this respect, I believe, the book is unique. My aim has been to make these reminiscences not only interesting but amusing, and as to how far I have been successful in this I must leave my readers to decide. "Nil sine labore."

Unless by the words "any other engineer" Mr. Boulnois means it to be understood any other *municipal* engineer had previously written his own life, he is in error, as witness at least the one example of McCarthy's

two lengthy volumes of "Incidents" noted in this section Dec. 11-18, 1919, p. 1021, and Oct. 21, 1920, p. 807. This oversight, however, in no way detracts from the value and interest of Mr. Boulnois' "Reminiscences." In fact, it only reinforces the general argument for more autobiographies by engineers since the "Incidents" as well as the "Reminiscences" so greatly enrich engineering literature. It may be noted in passing that another British municipal engineer rendered a distinctive service to engineering literature a few years ago. We refer to "The River Irwell: Pleasant Reminiscences of the Nineteenth Century and Suggestions for Improvement in the Twentieth Century," by J. Corbett, borough engineer of Salford (*Engineering News*, April 16, 1908, p. 441). Mr. Corbett's book was to some extent autobiographical, since among other things recorded he told of work he had done as member of the Salford Council for five years and as borough engineer for fifteen years to clean up and improve the River Irwell.

During his forty years in municipal engineering work, Mr. Boulnois was successively surveyor of Exeter (1874-83), engineer of Portsmouth (1883-90), engineer of Liverpool 1890-7 and inspector and then deputy chief engineering inspector of the British Local Government Board, retiring from the latter position by age limitation in 1911. From that date until the war broke out Mr. Boulnois was in consulting practice.

Mr. Boulnois' engineering education, so far as schooling was concerned, was obtained in the School of Applied Science of King's College (London), which at that time shared with Trinity College (Dublin) the distinction of being the only university where engineering was taught in England, Mr. Boulnois states. When Mr. Boulnois entered the school mentioned, in the spring of 1862, the staff consisted of Charles Percy Bysshe Shelley, brother of the celebrated poet, as professor of mechanics, and four others who taught (1) geometry, (2) chemistry, (3) surveying and (4) geology and mineralogy. There was "no chair of sanitary science, and in those days," Mr. Boulnois states, "it is doubtful if there were many men in the whole of the United Kiugdom who knew anything at all about sanitation."

Leaving King's College toward the end of 1863, Mr. Boulnois was engaged, for about a year, "as a sort of unpaid assistant" to a French engineer who had charge of some railway construction in France. On Jan. 1, 1865, Mr. Boulnois was articled to Joseph Bazalgette, who was then engaged, besides his private practice, as chief engineer of the London Metropolitan Board of Works. The pupilage expired in 1869, but Mr. Boulnois was retained by Mr. Bazalgette for another year as an assistant on various private works. Of his articles to Mr. Bazalgette, Mr. Boulnois writes:

> One of the few documents I have preserved is that of my articles, in which I am described as "an infant of the age of 19 years," and in which it is stated that the premium paid was £420. Further, that I became his "pupil and apprentice in the profession, business, or employment of a civil engineer," and that I bound myself to "faithfully, diligently, and honestly serve him and obey his lawful commands," and also that I should "in all respects demean and behave myself as a good, true and faithful pupil and apprentice." At the same time my guardians, who were my mother and my eldest brother, undertook to "find and provide me sufficient meat, drink, lodging, clothes, washing, medicine, medical attendance, and all other necessaries." For all this my "master" agreed that he "should and will according to the best of his skill and knowledge, teach and instruct, or cause to be taught and instructed the said (me) as his pupil and apprentice in the practice, profession, business, or employment of a civil engineer," and a great deal more of the usual legal jargon.

Mr. Boulnois gives as one of the reasons for quoting extracts from his articles the fact that "the question of the proper wording of articles of indenture of engineering pupils is being considered at the present time."

Between the period of his service with Mr. Bazalgette, Mr. Boulnois was for a year or so in Jamaica as district engineer under the surveyor general, engaged chiefly on construction and repair of government buildings, bridges, etc., and for a few months he was in Buda Pesth with a former fellow pupil who had a contract for asphalt pavement construction.

While at Exeter Mr. Boulnois conducted one of the earliest water-main scraping operations for the removal of incrustation. This was "about the year 1880." The work is described in some detail in the book before us. Donald Cameron, who later on introduced the septic tank, was chief assistant to Mr. Boulnois at Exeter.

In the portion of his book devoted to his experiences at Liverpool, Mr. Boulnois gives some very interesting information regarding the Liverpool Health Act, passed by Parliament in 1842, which he says was "the first act ever obtained which contained power to enforce sanitary regulations." In 1846 the Liverpool Sanitary Act empowered the council to appoint, subject to approval by one of the principal secretaries of state, "a person duly qualified as a civil engineer to act as local surveyor" and by an act of Parliament in 1854 it was provided that this official should be known as "the borough engineer."

Here and there through the volume, and particularly in its closing chapter, Mr. Boulnois recounts various literary activities, not all of which were confined strictly to engineering subjects. In 1883 he published "The Municipal and Sanitary Engineers' Handbook." His "Modern Roads" was noted in this section, April 15, 1920, p. 784.

One of Mr. Boulnois' more distinctively literary efforts was a paper before a literary and scientific society on Du Maurier's "Peter Ibbetsen." This paper, having been sent to the author, brought out a very interesting letter which is published in Mr. Boulnois' "Reminiscences," followed by a critical comparison by Mr. Boulnois of "Peter Ibbetsen" and "Trilby." Mr. Boulnois prints in his concluding chapter some verses entitled "The Tale of a Newly-Made Road," beginning:

> Scarcely had the roller left it, left it a compacted mass,
> Than a dark-browed man surveyed it, said there was a smell of gas—
> Sent for ruthless men who dug it, dug it out in trenches wide,
> Filled these chasms up at random, caring not if they'd subside.
> Forthwith came a gaunt inspector, said a water-main had burst,
> Followed suit, and dug more trenches—of the two he was the worst.

There is also reprinted a short story by Mr. Boulnois and a single-act play taking off a local government board inquiry.

We have given a large amount of space to this little book because of its interest and in the hope that by calling attention to it there may be stimulated further additions to the scanty list of engineering autobiographies.

Iron and Steel Making

REVIEWED BY W. P. BARBA
Formerly Vice-President, Midvale Steel Co., Philadelphia, Pa.

THE MAKING, SHAPING AND TREATING OF STEEL—By J. M. Camp and C. B. Francis. Second Edition. Pittsburgh, Pa.: The Carnegie Steel Co. Leather; 5 x 8 in.; pp. 614; illustrated. $5.

Characterized briefly, this book, now in its second edition, is a much-needed contribution to the elementary literature of iron and steel making. In the reviewer's forty years of active experience in the making of fine steels, there has always been apparent the utter lack of a book so elementary that it could be given to a man not specifically trained in the art. There was no book that did not demand a basic knowledge of chemistry, of physics and of mechanical practice, including a good deal of electrical engineering.

The book under review, primarily prepared to instruct the large sales force of the U. S. Steel Corporation, has largely a local application in its descriptions of plants and equipment. However, it has been broadened and amplified so that it almost covers the requirement noted. The definitions are in plain language and are complete and highly informative. Although in some cases they do require further research by the reader into the original sources, this further research is stimulated, and the direction well indicated.

All praise is due the authors for the illuminating and interesting way in which they have handled in ten pages of the first chapter what a second-year college student would take a term to acquire from the original sources. In the chemical section, covering the atomic theory and the laws of combining by definite proportions, a more difficult task is set the student; the description of elements and the basic definitions, however, is particularly concise. The section on ores, raw materials and refractories, again, is plain, easy reading.

"Fuels" begins with an introduction, comprising in the briefest form known to the reviewer the laws covering the use of fuel and the data necessary to support these laws. Down to where pyrometers are treated, this chapter is wholly commendable. But as to pyrometers, the whole book is deficient in its treatment of the requirements and usefulness of pyrometric measurement, and it is recommended that when the third edition is brought out, the section on pyrometric work be amplified.

There is some redundancy in the description of the composition and chemical makeup of the compounds entering liquid fuels, and the effect on the reader is likely to be confusing. But when gaseous fuels—chiefly those prepared from coal—are treated, the book is complete and informing. The powdered coal section might well be amplified in a later edition, since there is within reasonable view an end of the natural gas supply in the iron and steel district, and recourse is even now being had to powdered coal and colloidal fuels. The chapter on "Fluxes and Slags" is, if anything, too detailed, yet somewhat incomplete. The casual reader must discriminate between the excellent short definitions and the widely extended chemistry of these difficult compounds.

Manufacture of pig iron is treated in an easy, intelligent manner, and the only lack noticed by the reviewer is that no particular mention is made of the Gayley method of refrigerating the blast, in order to remove moisture and standardize the water content of the air sent through the blast furnace. Particular commendation should be given the very comprehensive collection of data carried by Fig. 23 on p. 168, since the number of men, even metallurgists, who know that it requires 16,458 lb. of material to produce 2,240 lb. of pig iron is limited. The whole chapter on the reactions of the blast furnace is very useful and easily understood.

Under the head of the Bessemer process, particular attention is directed to the authors' definition of "steel," (a difficult matter), which will leave no doubt in the mind of even a court or a jury as to the distinction between steel and the other varied forms of iron manufacture.

The authors give an adequate historical description of the basic openhearth process and its principles. While it does not pretend to be a comprehensive study of steelmaking in the basic openhearth, there is inherent evidence that the authors have complete knowledge of good practice in the making of basic steel. In turn, they make the statement that in no plant of the Carnegie Steel Co. is there an acid openhearth furnace at work, and in so far as they fail to deal with acid openhearth practice the book is not a comprehensive compendium of the steel manufacturing industry.

Attacking the comparatively new subject of electric furnace manufacture of steel, the authors have seen fit to give a great deal of space to a discussion and development of technical laws which, in the opinion of the reviewer, serve to complicate the thought of the untrained reader before he approaches the fundamental statement that in the electric furnace the electricity is merely a superior and easily controlled form and source of heat, enabling high temperatures to be reached and controlled, and in a controlled atmosphere, as required for the ultra-refinement process looked for in the electric furnace. The diffuse statements concerning the use of electric current for the production of this heat might well be modified. As to furnaces and their operation, however, the descriptions of the authors are most satisfactory. The chapter is closed by an excellent summary, and but one suggestion needs to be made: The summary should state that the electric furnace process does not of itself guarantee that the product is of ultra-refinement.

The largest single section of the book is taken up with the shaping of the steel and the mechanical properties of steel. This is easy, plain reading. Chapter IV on the Making and Preparation of Ingots, with a large amount of information, makes but one reference to bottom-poured ingots, although in the East most ingots for the rolling of plates are bottom-poured, while in the West this is less usual. It is the reviewer's belief that in a subsequent edition the authors should give some attention to bottom pouring.

Attention may be directed to the instructive diagrams of rolls, roll passes and the manner of the reduction of section.

The discussion of defects and their causes, p. 413-415, should be studied and memorized by everyone using or producing steel. These short three pages give a common meeting ground which will solve more sales difficulties, if thoroughly absorbed and practiced, than any other three pages in the book.

The section on forging of axles, etc., is rather too detailed a description of a particular plant to be useful in a general textbook, and hence must be considered mainly as special information, but interesting in that

the practice described is advanced practice. The last paragraph of this section, Advantages of Heat Treating Axles, is one of the few instances in this book of argumentative reasoning, but the reviewer bears testimony to the soundness of the argument here advanced.

Part III, The Constitution, Heat Treatment and Composition of Steel, is one of the most fundamentally difficult sections of the book. The authors essayed to make plain to the casual reader many of the newer and most abstruse observations developed by the use of microscopic research methods and of the theories which underlie them. Again the authors have done a good piece of work, and one who reads what they have offered and supplements it with even a little special following-up from original sources will have a knowledge of a subject which only a very few years ago was confined to a few highly specialized laboratories in large universities.

Thin paper, good printing and flexible back combine to make a convenient light-weight book of 614 pp., which should be in the traveling bag of every salesman and on the desk of every purchasing agent and works executive handling steel products. Its contents should be in the possession of everyone who produces, uses or deals with this material, which is the base of the business pyramid of the world.

A Memorial Pamphlet

THE DISCOVERY OF ELECTROMAGNETISM MADE IN THE YEAR 1820—By H. C. Oersted. Copenhagen, Denmark: Published for the Oersted Committee at the Expense of the State by Absalon Larsen.

Facsimile reproductions of the original Latin pamphlet of the Danish physicist Hans Christian Oersted; entitled, "Experimenta Circa Effectum Conflictus Electrici in Acum Magneticam" and of translations published soon afterward in French, Italian, German and English, together with a Danish reprint. The English translation appeared in 'Annals of Philosophy," Vol. XVI, pp. 273-76, London, 1820. A short preface in French and in English gives a biographical sketch of Oersted.

Oersted's essay is worthy of a high place in technical literature, not only because of its historical and scientific importance but also as an example of clear and concise writing. The biographical preface says: "The pamphlet is very much condensed; in fact, it is so brief that in many parts of it each line can be said to describe an experiment."

It may be added that Oersted was professor of physics at the University of Copenhagen; made many researches and wrote numerous technical works; was of "a very poetical nature"; "stood in close relation to most of the leading intellectuals of the day; was the "good genius of the world-famed poet, Hans Andersen," and wrote a pamphlet on "The Spirit in Nature."

Naval Consulting Board

NAVAL CONSULTING BOARD OF THE UNITED STATES—By Lloyd N. Scott, Late Captain, U. S. A., and Liaison Officer to the Naval Consulting Board and War Committee of Technical Societies, from Inventions Section General Staff, U. S. A. Washington, D. C.: Navy Department. Cloth; 6 x 9 in.; pp. 288; illustrated.

Although the preliminary chapters on the remarkable work of the industrial preparedness campaign of the Council of National Defense are somewhat fulsome, the main part of this book, describing the activities of the Naval Consulting Board, is well worth while. The author assumes personal responsibility for all of his statements but the publication is official. It reveals many of the secrets of war invention and illuminates the difficulties of the inventions boards which had to deal with thousands of patriotic citizens whose zeal to help the Government far outweighed their technical ability or knowledge of the state of the arts they were trying to improve.

Library of Reclamation Service

A reference library of 3,000 volumes is maintained at the Washington office of the U. S. Reclamation Service. Every year a history of the progress of each project is prepared by the engineer in charge. There are now more than 1,000 of these project histories on file. In the section devoted to the histories there are included specifications, plans, photographs and cost data. The engineering section contains 400 selected books on irrigation and engineering subjects. Other sections relate to public documents of the Reclamation Service, related departmental publications, state publications and periodicals. More than 100 foreign engineers and officials have taken advantage of the library's facilities.

For schools, colleges and associations the library has a dozen motion picture films which it loans on request. Official photographs and slides of construction, operation and settlement are on sale at estimated cost.

In the recently issued "*List of Publications No. 5*," a 6 x 9-in. pamphlet of 95 pp., there is noted a list of standard designs on which the Denver office has been at work for several years. These designs are the "shelf hardware," so to speak, of an irrigation works for they represent the combined experience of all the projects. The subjects include gates, bridges, buildings, checks, drops, pipe, concrete turnouts and weirs.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other person indicated.]

THE ATLAS HANDBOOK ON CONCRETE CONSTRUCTION—New York: The Atlas Portland Cement Co. Flexible Cover; 4 x 7 in.; pp. 144; illustrated. $2.

A very complete condensation of the art and practice of making concrete. Useful for the amateur and with some information of value to the professional. Announced as costing $2 but probably available for nothing to those who deserve it.

BUREAU OF MINES: Report by the Director to the Secretary of the Interior, 1920—Washington, D. C.: The Bureau. Paper; 6 x 9 in.; pp. 149; illustrated. 15c. from Superintendent of Documents.

CANADIAN CANAL STATISTICS, 1919: Prepared in collaboration with the Department of Railways and Canals, Ottawa, Can.: Dominion Bureau of Statistics. Paper; 7 x 10 in.; pp. 55.

CHIEF OF ENGINEERS, U. S. ARMY: Report to the Secretary of War, 1920—Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 2088.

COMMISSION ON WATERWAYS AND PUBLIC LANDS: Report, 1919—Boston, Mass.: The Commission. Cloth; 6 x 9 in.; pp. 96.

COMPRESSED AIR PLANT: The Production, Transmission and Use of Compressed Air, with Special Reference to Mine Service—By Robert Peele, Mining Engineer and Professor of Mining in the School of Mines, Columbia University. Fourth Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 506; illustrated. $4.50.

In this edition a chapter on "Measurement of Air Consumption" has been added and a note on "important" air lift-work at a

mine in Mexico has been inserted. The first edition was reviewed in *Engineering News*, Sept. 17, 1908, p. 319, and in *Engineering Record*, Sept. 26, 1908, p. 363.

CONFERENCE ON EMPLOYMENT AND EDUCATION: Held by the American Association of Engineers, Report, 1920—Chicago, Ill.: The Association. Paper; 6 x 9 in.; pp. 48.

CONTRACTS IN ENGINEERING: The Interpretation and Writing of Engineering-Commercial Agreements—By James Irwin Tucker, B.S., LL.D., Assoc. M. Am. Soc. C. E., Chief Engineer, Continental Asphalt & Petroleum Co., etc. Second Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 331. $4.

The first edition was noticed in the Engineering Literature Section of *Engineering News*, Oct. 13, 1910, p. 25, and in *Engineering Record*, Nov. 12, 1910, p. 558. The present edition contains approximately 25 pp. more than first.

DEPARTMENT OF HIGHWAYS OF THE PROVINCE OF SASKATCHEWAN, CANADA: Report, 1919-20—Regina, Sask. Can.: The Department. Paper; 7 x 10 in.; pp. 113; illustrated.

DER EISENBETON SEINE BERECHNUNG UND GESTALTUNG—Von Rudolf Saliger, Dr.-Ing., ord. Professor der Technischen Hochschule in Wein. Vierte nue Bearbeitete und Erweiterte Auflage. Stuttgart, Germany: Alfred Kröner. Paper; 7 x 10 in.; pp. 552; illustrated. Paper, 44m. Bound, 54m.

DIE MASCHINEN-ELEMENTE IHRE BERECHNUNG UND KONSTRUKTION: Mit Rücksicht Auf Die Neueren Versuche—Von C. Bach, Dr.-Ing., Württ, Staatsrat, Professor Des Maschinen-Ingenieurwesens, Vorstand Des Ingenieurlaboratoriums Und Der Materialprüfungsanstalt Der Technischen Hochschule Stutthart. Swölfte, Stark Vermehrte Auflage. Erster Band, Unter Mitwirkung von Dipl.-Ing. Julius Bach, Stuttgart, Germany: Alfred Kröner. Paper; 8 x 11 in.; pp. 504; illustrated.

THE ESSENTIALS OF DESCRIPTIVE GEOMETRY—By F. G. Higbee, M. E., Professor and Head of Department of Descriptive Geometry and Drawing, The State University of Iowa. Third Edition, Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 218; illustrated. $2.25.

In this edition changes in text and illustrations have been made along lines indicated by classroom use. The first edition was noticed in *Engineering News*, Sept. 16, 1915, p. 551.

THE ELECTRIC FURNACE—By Henri Moissan. Authorized Translation by Victor Lenher, Ph.D., University of Wisconsin. Second Edition. Easton, Pa.: The Chemical Publishing Co. Cloth; 6 x 9 in.; pp. 313; illustrated. $3.50.

Apparently a reprinting merely of a translation first published in 1904. Describes various forms of furnaces employed by the author in research work and the researches made therewith.

THE FEDERAL WATER POWER ACT: With a History of Water Power Legislation and a Topical Synopsis—Washington, D. C.: Black, McKenney & Stewart, Engineers. Paper; 6 x 9 in.; pp. 37.

A useful codification of the water-power act, and a reprint of the act itself.

FRANKLIN AND MacNUTT'S PHYSICS TEXTS: For Colleges and Secondary Schools—By William S. Franklin and Barry MacNutt. LESSONS IN MECHANICS; pp. 221; $2. LESSON IN ELECTRICITY AND MAGNETISM, pp. 254; $2.25; LESSON IN HEAT, pp. 147; $2. Bethlehem, Pa.: Franklin and Charles. Cloth; 6 x 9 in.; illustrated.

HOW TO KEEP INVENTION RECORDS: Together with an Explanation of the Nature of Industrial Property—By Harry A. Toulmin, Jr., J.D., Litt.D.; with an Introduction by James T. Newton, Sometime U. S. Commissioner of Patents. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 85. $2.

INDUSTRIAL MACHINERY IN FRANCE AND BELGIUM—By Charles P. Wood, Trade Commissioner. Washington, D. C.: Bureau of Foreign and Domestic Commerce. Paper; 6 x 9 in.; pp. 61; illustrated. 10c. from Superintendent of Documents.

INLAND AND COASTWISE WATERWAYS SERVICE: Report of the Chief to the Secretary of War, 1920—Washington, D. C.: The Service. Paper; 6 x 9 in.; pp. 138; illustrated.

INTERSTATE COMMERCE COMMISSION: Report, 1920—Washington, D. C.: The Commission. Cloth; 6 x 9 in.; pp. 205.

LANDSCAPE-GARDENING—By O. C. Simonds—New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 338; illustrated. $6.

LEHRBUCH DER MATHEMATIK HERAUSGEGEBEN VON ESSELBORN: Erster Band; Algebra, Geometrie der Ebene und des Raums, Darstellende Geometrie, Schattenkonstruktionen, Perspektive—Bearbeitet von F. Meisel, H. Roth, E. H. Schutz; pp. 613. Zweiter Band; Trigonometrie, Analytische Geometrie, Differential- und Integralrechnung, Mechanik, Festigkeitslehre, Baustatik—Bearbeitet von G. Ehrig G. Chr. Mehrtens; pp. 770. Leipzig, Germany: Verlag Von Wilhelm Engelmann. Paper; 8 x 11 in.; illustrated. Each volume; paper, 64m.; bound, 79m.

LOUISIANA ENGINEERING SOCIETY: Proceedings, Dec., 1920—New Orleans, La.: The Society. Paper; 6 x 9 in.; pp. 328; illustrated.

THE MINING LAWS OF THE BRITISH EMPIRE AND OF FOREIGN COUNTRIES: Vol. I. Nigeria—By Gilbert Stone, Sometime Scholar of Caius College, Cambridge, Tancred Student of Lincoln's Inn, of the North-Eastern Circuit, etc. London, Eng.: Imperial Mineral Resources Bureau. Cloth; 6 x 9 in.; pp. 254.

MODERN WELDING METHODS: Oxy-Acetylene, Thermit, Electric Arc and Resistance; A Complete Treatise of the Art of Joining Metals Based on Data Furnished by the Leading Authorities on This Subject—By Victor W. Page, M.S.A.E., Author of "The Modern Gasoline Automobile," etc. New York: The Norman W. Henley Publishing Co. Cloth; 6 x 9 in.; pp. 292; illustrated. $3.

MUNICIPAL LANDING FIELDS AND AIR PORTS: With Chapters by the Chief of the Army Air Service, the Director of Naval Aviation, and their Officers in Charge of Landing Field Operations—Compiled and Edited by Gearge Seay Wheat. New York and London: G. P. Putnam's Sons. Cloth; 5 x 8 in.; pp. 96; illustrated. $1.75.

NATIONAL ASSOCIATION OF RAILROAD TIE PRODUCERS: Proceedings, 1920. St. Louis, Mo. E. E. Pershall, Secy. Paper; 6 x 9 in.; pp. 138.

NEW YORK PUBLIC SERVICE COMMISSION FOR THE FIRST DISTRICT: Report, 1917—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 1047.

NEW YORK STATE CITY PROBLEMS: 1920 Proceedings of the Eleventh Annual Meeting of the Conference of Mayors and other City Officials. Albany, N. Y.: Secy., Wm. P. Capes. Paper; 6 x 9 in.; pp. 146. $1.

NEW YORK STATE DEPARTMENT OF HEALTH: Report, 1918. Albany, N. Y.: The Department. Cloth; 6 x 9 in.; pp. 365.

ONTARIO PROVINCIAL BOARD OF HEALTH: Report, 1919—Toronto, Can.: The Board. Cloth; 7 x 10 in.; pp. 295; illustrated.

PENNSYLVANIA DEPARTMENT OF LABOR AND INDUSTRY: Vol. VII, No. 6; Report of the Activities of the Industrial Board; pp. 46; No. 7; What Pennsylvania is Doing for Safety and Safety Codes—By Dr. Clifford B. Connelley, Commissioner. pp. 20. Harrisburg, Pa.: The Department. Paper; 6 x 9 in.

THE PRACTICAL DESIGN OF PLATE GIRDER BRIDGES—By Harold Hughes Bird, Assoc. M. Inst. C. E., Assoc. M. Inst. Mech. E. Philadelphia, Pa.: J. B. Lippincott Co. London: Charles Griffin Co., Ltd. Cloth; 6 x 9 in.; pp. 180; illustrated. $4.

For "young engineers and draftsmen engaged on the design of constructional steel work," particularly "for those whose training has been more on the theoretical than the practical side."

THE PRACTICE OF RAILWAY SURVEYING AND PERMANENT WAY WORK—By S. Wright Perrott, M. A. I., M. Inst. C. E., Professor of Civil Engineering in The University of Liverpool and F. E. G. Badger, A. M. Inst. C. E., Director of Housing of the City of Liverpool, etc. New York: Longmans, Green and Co. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 303; illustrated. $10.50.

PRINCIPLES OF HUMAN GEOGRAPHY—By Ellsworth Huntington, Research Associate in Geography, Yale University and Sumner W. Cushing, Late Head of the Department of Geography in the State Normal School, Salem, Mass. New York: John Wiley & Sons, Inc. London: Chapman & Hall Ltd. Cloth; 6 x 9 in.; pp. 430; illustrated. $3.50.

PUMPING BY COMPRESSED AIR—By Edmund M. Ivens, B.E., M.E., M. A. S. M. E. Second Edition, Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 226; illustrated. $4.

Some 30 pages of text and 18 illustrations, together with several formulas and tables have been added to this edition, consisting "principally of some very reliable and carefully compile operative data." The first edition was noticed in *Engineering Record*, Oct. 30, 1914, p. 494, and in *Engineering News*, Nov. 19, 1914, p. 1048.

REORGANIZATION OF SCIENCE IN SECONDARY SCHOOLS: A Report of the Commission on the Reorganization of Secondary Education, Appointed by the National Education Association. Washington, D. C.: Bureau of Education. Paper; 6 x 9 in.; pp. 61. 10c. from Superintendent of Documents.

RESEARCH AND METHODS OF ANALYSIS OF IRON AND STEEL—Second Edition—Middletown, Ohio: The American Rolling Mill Co. Limp Karotel; 6 x 9 in.; pp. 220; illustrated. $4.

SOUTH AUSTRALIAN RAILWAYS COMMISSIONER: Report, 1919-20—Adelaide, Australia: The Commissioner. Paper; 8 x 13 in.; pp. 53.

STATISTICS OF EXPRESS COMPANIES IN THE UNITED STATES: Report, 1919—Washington, D. C.: Bureau of Statistics. Paper; 8 x 10 in.; pp. 12.

STRAIGHT BUSINESS IN SOUTH AMERICA—By James H. Collins. New York and London: D. Appleton and Co. Cloth; 5 x 8 in.; pp. 305. $2.50.

The publisher's wrapper describes this book as one that gives practical information as to exactly what business conditions are in South America, and a first-hand account of how business is best conducted there, either on the spot by the traveling man or from the home desk.

TASMANIA HYDRO-ELECTRIC DEPARTMENT: Report, 1919-20—Hobart, Tasmania: The Department. Paper; 8 x 13 in.; pp. 39; illustrated.

TESTS OF METALS AND OTHER MATERIALS: Report made in the Ordnance Laboratory at Watertown Arsenal, Mass., 1918—Washington, D. C.: War Dept. Cloth 6 x 9 in.; pp. 329; illustrated.

UNITED STATES COAST AND GEODETIC SURVEY: Report of the Director to the Secretary of Commerce—Washington, D. C.: Department of Commerce. Cloth; 6 x 9 in.; pp. 173; folding maps.

WATER PURIFICATION PLANTS AND THEIR OPERATION—By Milton F. Stein, M. Am. Soc. C. E. Second Edition. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 270; illustrated. $3.

Notices of the first edition of this valuable work appeared in *Engineering Record*, Aug. 28, 1915, p. 268, and in *Engineering News*, Dec. 16, 1915, p. 1172. In the present edition, Chap. IV., on bacterial tests and parts of Chap. V., on interpretation of such tests have been entirely rewrittten to cover changes in technic and interpretation.

WIE MACHT MAN ZEITSTUDIEN? Arbeits- und Zeitstudien zur genauen Festsetzung von richtigen Stücklöhnen in Maschinenfabriken—Von Oberingenieur Eduard Michel, Beratendem Ingenieur, Obmann des Ausschusses für Zeitstudien heim A. w. F. Berlin. (Nach Taylor und Merrick) Nach einem Vortrage vor dem Ausschuss für wirtschaftliche Fertigung mit Aussprache und Nachwort. Berlin, Germany: Vereines Deutscher Ingenieur. Paper; 6 x 9 in.; pp. 167; illustrated. Paper; 20m.; Bound 23m.

WIRTSCHAFTLICHE VERWERTUNG DER BRENNSTOFFE: Kritische Betrachtungen Zur Durchführung Sparsamer Wärmewirtschaft—Von Dipl-Ing G. De Grahl, Baurat Berlin-Schöneberg. Zweite, Den Schwierigen Wierigen Wirtschaftlichen Verhältnissen Angepasste und Daher Vollständig Neu Bearbeitete Auflage. Berlin Germany: Druck und Verlag Von R. Oldenbourg. Paper; 8 x 11 in.; pp. 487; illustrated.

THE WORLD ALMANAC AND ENCYCLOPEDIA, 1921—New York: The Press Publishing Co., Pulitzer Bldg. Paper; 5 x 8 in.; pp. 896; illustrated. 65c. postpaid.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worthwhile letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Revenue from Garbage Incineration Uncommon This Side the Atlantic

Sir—In an editorial note in your issue of Jan. 6, 1921, p. 6, you state: "The installation and operation of incinerators or destructors requires much capital and yields no revenue." The record of many destructor installations in England shows that they have yielded a revenue for years, and whereas the art of building and operating destructors has not received so much attention in this country as it has in England, revenue in the form of steam for power has certainly been produced for a term of years at Westmount, Que., Milwaukee, and Savannah. The experience gained at these plants has pointed out the way to production of greater revenues in future installations, which condition will be automatically improved by the rising cost in fuel.

Furthermore, it may be said that no discussion of the various means of disposal of city refuse is fair to the destructor which does not call attention to the advantage which the destructor possesses, in that it does not need to be located at a point remote from the collection district, thus saving cost and nuisance of the long haul, which would stand on the same side of the balance sheet as a revenue.

E. H. FOSTER,
New York City, Jan. 10. Power Specialty Co.

[Space limitations confined us to broad generalizations in the note in question. It is quite true that in Great Britain the utilization of heat from refuse destructors is common. But in the United States and Canada, most of the garbage furnaces are of the low- or medium-temperature type which produce no steam while of the thirty high-temperature destructors in the two countries, the three named by Mr. Foster are the only ones so far as we know that produce steam that is used commercially. At Milwaukee the steam went to waste for some time after the destructor was put in use, and although we have tried repeatedly we have never been able to get any figures showing definitely what the net gain to the city is from the destructor steam, after taking into account the extra capital and operating expenses necessary to generate and utilize the steam.

As to haulage economies due to the central location of refuse destructors, both at Milwaukee and Savannah (we cannot say as to Westmount), sites for the destructors might have been used for garbage reduction works with little if any more reasonable ground for complaint. The new sewage-works at Milwaukee will be close by the destructors. Furthermore, reasonable complaints against garbage disposal works of any kind, properly designed and operated, are generally due more to the concentration of the garbage than to its treatment. But public sentiment and prejudice have to be reckoned with, and these are stronger against reduction works than furnaces—largely because popular conceptions of garbage disposal are due to uninformed and ill-informed medical men whose limited teaching on the subject has been to the effect that burning garbage is a sanitary rite, a burnt offering to Hygeia.

Nevertheless, the relative lengths of hauls to garbage disposal sites available for hog feeding, reduction or incineration, should always be taken into account in comparing the total costs of garbage collection and disposal, as we intimated, at least indirectly, in the closing words of the note in question.—EDITOR.]

Pulling Stumps With Gin Poles

Sir—In the issue of *Engineering News-Record* of Dec. 9 an article under the heading of "Stumps Pulled by Gin Poles" on p. 1153, written by Jacob L. Crane, Jr., gives credit to Thomas Kelshaw as having devised this scheme. Speaking in the vernacular, this scheme is covered with gray whiskers.

For the past 15 years, where extensive clearing operations were carried on in this Province, it has been performed in most cases by a method similar to that described in the article referred to, generally upon a larger scale.

Large logging donkey engines were used and the gin poles of sufficient length to enable the contractor to pile up the logs and stumps from a radius of 1,500 ft. around the gin pole—these piles sometimes being built up to a height of over 100 ft. A patent grabhook was generally attached to the log or stump, by which means it was released (after being placed on the pile) when the haul-back line was put into operation. This system obviated the necessity of keeping a man up on the pile to release the "choker." The crew necessary for the work was usually as follows: One foreman, one engineman and fireman, one powder man, two men preparing stumps for blasting, three chokermen and one roustabout—a total of ten men.

Extensive areas of the Vancouver townsite and the adjoining municipalities were cleared in the manner above described.

H. M. BURWELL,
Dec. 18, 1920. Consulting Engineer.

Highway Research

Sir—In *Engineering News-Record* Nov. 18, 1920, p. 1010, there appears an interesting news item under the caption "National Research Council Forms Comprehensive Highway Investigating Body, Advisory Board on Highway Research to Co-ordinate All Research Agencies, Federal Aid to Be Sought." The object to be attained through the investigations proposed are certainly worthy. For a long time it has been a source of regret to those who are interested in developing the best plans for highway building that there has been no such central research body as is proposed by the National Research Council. Unquestionably the research work has been inefficient through the multiplicity of agencies—generally with insufficient funds—making the investigations. Unquestionably, also, the public generally has not understood the reasons for highway construction as practiced because there has been no authoritative central body to give out clear-cut statements showing why it was necessary to undertake the plans followed. It seeems only fair, however, to offer a word of warning at this time when it is so clearly incumbent upon Congress to economize in every possible way. It would seem since there are already governmental agencies making such investigations as are discussed in the article referred to that these agencies should be clearly specified as the proper ones to carry on the research work in the most thorough manner possible and that all other agencies cooperate, and perhaps combine with this agency, in making the desired investigations. It is unfortunately often true that it is easier to get funds from Congress for something that is new, and perhaps spectacular, than it is to provide adequately for the bureaus and divisions already organized for work, and doing, probably, much more than could be expected with the insufficient funds available.

Several years ago the writer wrote an article, which was widely copied at the time, urging a general plan of road buidling with research work supervised by the federal government and carried on under a bureau of roads. He still believes that plan to be the logical one to be pursued rather than to scatter the funds through the creation of new agencies. Should a U. S. department of public works be established it would obviously be the proper agency for having general supervision of such investigations as are proposed; but the establishment of a new research body within one of the existing departments, or independent of all of the departments, would probably be the addition of one more unit to an already inefficient system.

Denver, Dec. 27, 1920. HIGHWAY ENGINEER.

Air-Inlet Valves for Pipe Lines

Sir—In the article by H. L. Thackwell, in *Engineering News-Record*, Jan. 13, p. 76, the rule for designing air-inlet valves for pipe lines, credited to the "American Civil Engineers' Pocket Book" is not correctly quoted. That rule is found on the bottom of p. 1246 and reads: "As a general rule air valves with a diameter of one inch for each foot in diameter of the water pipe are sufficient." The rule calls for one inch in diameter instead of one square inch in area for each foot of diameter as wrongly quoted by the author.

This rule is empirical, but it is not as bad as the author makes it. Under it, with the entrances or escapes of air at a rate corresponding to a movement of water at a velocity of 4 ft. per second in the pipe, air will pass the valve at a velocity of 576 ft. per second and will require a head of about 10 ft. of water, or one third of an atmosphere, to make it pass the valve. Practical experience with pipe lines has convinced the writer that valves materially smaller than this are not satisfactory. On the other hand, larger valves are required only at the top of high and steep slopes where a break in the pipe, in the valley below, might result in a collapse of the pipe. Even in this case a valve of the size suggested, if it works, will do much toward breaking the vacuum and in most cases would be sufficient.

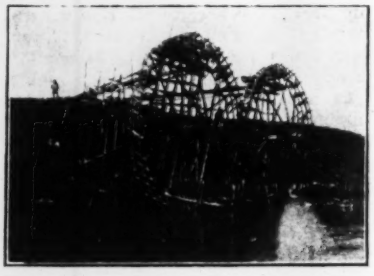
In a search of the literature on air inlets just made in my office by far the most complete discussion of the subject found was the article by M. L. Enger and F. B. Seely, of the University of Illinois, in *Engineering Record*, May 23, 1914, pp. 594-96.

ALLEN HAZEN,
New York City, Jan. 14. Consulting Civil Engineer.

Primitive Wheel-and-Bucket Pumps Used in China

Sir—Having seen in your issue of Sept. 2, 1920, p. 448, an article about different methods used in China for raising water for irrigation and other purposes, I am sending you photographs showing other pumping arrangements used in various places in China. The wheel shown in the view has buckets fastened to the rim. These buckets are so shaped and placed that they are filled when in the water and commence to empty when they get to one end of the trough along side and near the top of the wheel and are empty when the other end of the trough is reached. A dam designed for the passage of boats gives the head that drives the wheel.

The wheels vary in size, but have a diameter up to about 30 ft. They run unceasingly without any care or attention until stopped or a flood puts them out of order.



WHEEL-AND-BUCKET PUMPS IN CHINA

A number of wheels are placed along the rivers and, as they are never greased, they make a squeaking sound that can be heard for a considerable distance. These wheels are used in the province of Hunan; in the province of Szechnan more or less similar wheels are used. The pumps shown on the other two photographs [not reproduced] are similar but worked differently—one with man power and one by oxen. These pumps raise water some 5 to 6 ft. While excavating for bridge abutments in Hunan, and not having any other kind of pumps, I used the man-power pumps and by repumping every 5 ft. lifted water about 20 ft.

There are various other ways of raising water, all suited to the condition of the place. In some places, where the ground is too high for the man-power pumps and al too uneven for ditches leading to all the places whe water was to be used, one can see many poles put up a over the country. Another and smaller pole, to the mi dle of which is tied a rope, is hung from the top of th pole standing in the ground. On one end of the sma pole is put some clay-like earth which when dry adhere to the end of the pole; to the other end is hung a bucke By this arrangement water is easily raised from wells fo irrigation.

The Chinese are on the whole good mechanics and work men. If you give a foreman a drawing to a scale of ½ or ¼ in. to the foot he or some of his men will nail some boards side by side on planks and on them will make full-sized drawings of cornices, pillars, bases, doors, windows, etc., for foreign style brick buildings. His drawing instruments consist of a brush such as is generally used for Chinese writings, a square and a rule. While on railway building in Hunan, I had only two men who had been on such work and one who had been in a shop and one on housebuilding. The rest were natives, who had never seen a railway before; but we did all the work required—grading, bridges, of which there was quite a number, tracklaying and station buildings.

O. SHERVEN.
Bergen, Norway, Sept. 27, 1920.

Pavement Type Nomenclature

Sir—Mr. Pennybacker's letter printed in *Engineering News-Record*, Nov. 4, p. 908, has been read with some interest. The writer is of the opinion that, although perhaps from a strictly technical standpoint Mr. Pennybacker's contention that qualifying adjectives should precede the word "concrete" in naming pavement types has some merit, yet, as generally understood and accepted, the term "concrete" is sufficiently explicit to convey the meaning.

Not only engineers and contractors, but the general public as well, have become so thoroughly accustomed to thinking of a concrete pavement as one composed of portland cement, sand and stone as to make any further qualifications superfluous. In an experience of over twenty years the writer cannot recall a single instance of a misunderstanding arising from the use of the word concrete in this connection.

Would it not seem more logical to accept the word concrete as the definite name of a particular type of pavement and only qualify by such words as "asphaltic" when the cementing material is other than portland cement? or better still, adopt more definite names for the so-called "concretes" of other materials? Thus, machine-mixed bituminous pavements of asphalt or tar could be called "mixed-asphaltic-macadam" or "mixed-tar-macadam," to differentiate them from those built by the poured method.

E. G. ORBERT,
Milwaukee, Wis., Parsons & Orbert,
Dec. 15, 1920. Consulting Engineers.

The Mass Diagram in Railroad Grading Computations

Sir—Referring to an article on p. 1172 of your issue of Dec. 16, 1920, entitled: "Mass Curve Ordinates Computed by Aid of Adding Machine," I wish to call attention to the unprecedented wholesale use which has been made of the mass diagram in the distribution of grading quantities for the work of the Bureau of Valuation, Inter-State Commerce Commission.

In the Pacific district alone over 50,000 miles of railroad grading computations were handled in this manner. As may be imagined when a work of this magnitude was contemplated, it was necessary to systematize the computing and adopt all possible short cuts. Among these was the use of a computing machine, but, instead of using an ordinary adding machine, which was used by the author of the article referred to, it was found much easier to use a calculating machine of the Monroe type, which permitted the necessary subtractions by a simple reversal of direction in the turning of the crank, and made it unnecessary to "throw in" the nines. Another advantage in using this type of

machine on our work was that of making the necessary computations to take care of shrinkage and swell. No difficulty has been experienced in plotting the minus ordinates downward.

The specifications as finally adopted in the Pacific district include the following:

Free haul, team—500 ft.
Maximum haul, team—2,500 ft.
Swell, solid rock—10 to 35 per cent.
Swell, loose rock—10 per cent.
Shrinkage, all embankments—10 per cent (if over 5 years old.)

A number of rules for making a theoretical and economical distribution of material were adopted so that the same methods would be followed consistently on all our overhaul computing work.

On diagrams covering a series of cuts and fills balancing lines were drawn so that the economical haul was obtained. Briefly the location of these lines was determined by the following rules:

1. From one cut to one fill, make the maximum haul 2,500 ft.
2. From one cut to two fills, make the maximum haul equal in each direction.
3. In a series of cuts and fills, if the number of cuts is equal to the number of fills, or vice versa, make the sum of the maximum hauls in one direction 2,500 ft. greater than the sum of the maximum hauls in the other direction.
4. In a series of cuts and fills, if the number of cuts is one greater than the number of fills, or vice versa, make the sum of the maximum hauls in one direction equal the sum of the maximum hauls in the other direction.

H. J. SAUNDERS,
Supervising Engineer,
Interstate Commerce Commission.

San Francisco, Cal., Dec. 30, 1920.

Concrete T-Beam Designed as Truss

Sir—Recent communications to your journal regarding simple and safe methods of designing reinforced concrete seem to be much to the point. In an effort to arrive at the design of large T-beams by short but rational calculations the writer was led to the method shown in Fig. 1. The values shown in the stress diagram are slightly in excess of the actual stresses. The diagonal stresses in the middle half of the beam can safely be taken by the web.

Beams such as shown in Fig. 2 were designed and successfully built. They carry a dancing and drill floor. A heavy rain washed out the forms the night after these beams were poured, but a level failed to show any deflection the next day. Under full load the deflection was in the neighborhood of ¼ in. No cracks have shown in five years that are discernible to the unaided eye. The beams were built with a camber of ½ in.

It is recognized that the truss analysis does not apply rigidly to the beam. However, there are a large number of variables in such a beam, and also in any solution for same. The concrete itself may easily vary 5 per cent from its assumed value—or may vary that much in different beams. The load will never be exactly as assumed in the calculations, and, we have taken care of the variable effect of vibration by our "factor of doubt" (factor of safety).

We have also to consider that where a *simple* (approximate) method is used we may require a small additional amount of steel, or concrete, as the case may be, and we *save* the *value* of this on the drafting table and in the field.

JOHN B. HUTCHINGS, JR.

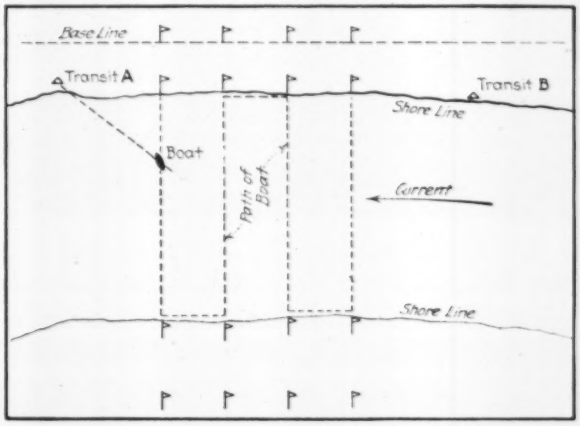
Asheville, N. C., Dec. 10, 1920.

Locating Soundings on Ohio River

Sir—I was interested in reading Mr. Thackwell's "A Few Useful Dodges in Surveying" in your issue of Dec. 16, p. 1164, especially "locating soundings." I would like to describe the method of locating soundings used in connection with preliminary and location surveys for the Ohio River locks and dams, as well as surveys for cross-sections for use in estimates.

A point on the shore was located and a base line run with stakes every 1,000 ft. for preliminary, 200 ft. for location and 50 ft. for construction. From these stations, lines were laid at right angles to the base line across the river and two stakes set for locating flags. The sounding party consisted of six men, as follows: In skiff, two oarsmen, one soundsman, one recorder; at transit, one observer, one recorder.

The recorder in the skiff directed the oarsmen to row across the river as indicated by the flags set on the shore



METHOD USED IN LOCATING SOUNDINGS

and recorded the readings as given him by the soundsmen. The observer at the transit kept the transit directed at the soundsman and at the moment of sounding stopped its movement, saying "read." The recorder at the transit read the angle, and said "check." Immediately the observer again moved the transit so that the center hair was on the soundsman and the operation was repeated. At every fifth sounding the recorder in the boat waved a flag and this was noted by the observer at the transit so that there was no chance that the soundings and the readings would not agree when they were plotted. By this method soundings could be taken very rapidly and as close together as the soundman could handle the rod.

This method gives very little chance for error unless the boat gets too badly off the line indicated by the flags on shore.

One season when considerable new blood was in the organization and more men were available a check survey was made as follows: Two men were added as another transit party located above the area to be sounded and the soundings located by the intersection of the two transit readings. The boat was held as nearly as possible to the cross lines as before, so that a check on the single intersection method was obtained. The result was very interesting. While plotting the soundings such remarks as: "That is where Jack nearly fell overboard"; "This is where that big log hit them," or "Remember how hard they had to row there to keep on the line" were frequent. The results showed that at no place were the soundings taken more than 15 or 16 ft. off the lines, and as the river bed was fairly uniform up and down stream it made no material difference which method was used.

C. R. ANDREW,
Miller, Holbrook, Warren & Co., Designing Engineers.

Decatur, Ill., Jan. 1.

The Hydraulic Jump

Sir—In your issue of Nov. 25, Julian Hinds, in his article on "The Hydraulic Jump," says near the bottom of p. 1039, "the first derivative of the area with respect to the depth is the width at the water surface." This would only be true in a rectangular section or where

$$A = d \times T$$

In case of a triangular section, for example,

$$A = \tfrac{1}{2} \times d \times T$$

and

$$\frac{dA}{dd} = \frac{T}{2}$$

This would give as a final formula

$$\frac{2A^3}{T} = \frac{Q^2}{g}$$

or

$$\frac{A}{T} = \frac{V^2}{2g} = hv$$

Equation (9) will be different for each type of section unless T is defined, not as the width at the water surface but as the average width.

JEPTHA A. WADE.

New York City, Dec. 17, 1920.

Bulking of Sand Noted Years Ago by Feret

Sir—In a note of yours entitled "Wet Aggregates Make Concrete Too Strong," in *Engineering News-Record*, June 24, 1920, p. 1267, the statement is made "When aggregates were proportioned by volume measure, as is customary on most construction work, it was found that the use of wet aggregates requires ½ to 1 bag more cement per cubic yard of concrete than do dry aggregates."

This statement is misleading, and contradicts not only the caption but also other statements in the text. Wet aggregates volumetrically proportioned do not require more cement per cubic yard of concrete than do dry aggregates; but, on the contrary, they require less, for the reason that a unit volume of moist aggregate contains a smaller mass, and consequently less surface area of aggregate than does a unit volume of dry aggregate.

TABLE I

Weight of water contained in 100 kg. of dry sand (wt. in kg.)		0	0.503	1	2	3	5	10
Loss in weight of 1 kg. wet sand after drying (in grams)		0	5.0	9.9	19.6	29.1	47.6	90.8
Dune Sand	Weight of one cubic meter of wet sand (kgs.)	1 458	1 310	1 238	1 213	1 209	1 208	1 266
Dune Sand	Weight of sand (dry) contained in cubic meter of wet sand (kgs.)	1 458	1 304	1 226	1 189	1 174	1.151	1.149
Beach Gravel	Weight of one cubic meter of wet sand (kgs.)	1 514	1 463	1 412	260	1 221	1.229	1 305
	Weight of sand (dry) contained in one cubic meter of wet sand (kgs.)	1 514	1 456	1 398	1 235	1 185	1.171	1.187

The importance of noting the percentage of moisture in sand for concrete work, so far as I know, was first emphasized in print twenty-eight years ago, by Feret, the French investigator. This authority on the properties of concrete aggregates and mortars, whose work might be profitably read by modern investigators, published an excellent paper (Sur La Compacité des Mortiers Hydrauliques, M. Feret, *Annales des Ponts et Chaussées*, Mémoires et Documents 7e série, Tome IV, 1892, 2e semestre, pp. 5-164.) supplemented with numerous ingenious curves and diagrams. Among other epoch-making experiments he described in detail the influence that various percentages of moisture exercise on the weight of sand and gravel contained in a unit volume, and in a table he showed the effect of moisture contents up to 10 per cent by weight. I have translated several paragraphs from Feret's paper and make the translation a part of this letter. These paragraphs deal with the effect of moisture on the weight of sand contained in a unit volume in one instance, and with the effects of moist sand upon the richness of mortars in another.

"*Influence of Moisture.*—One of the principal causes of error in the proportioning of mortars may be that there is extreme variation in the settling of the sand in the measuring boxes, this depending upon the percentage of moisture carried by the sand. Up to a certain limit, moisture has the effect of impeding the movement of the grains past each other, and consequently prevents the sand from being compacted.

"We have experimented with two samples of different sands, one being very fine, coming from Boulogne, and the other very coarse obtained on the coast, and used almost exclusively in construction at that port. These sands were shoveled as uniformly as possible into a box having a capacity of 50 liters similar to the standard wheelbarrows which are generally employed for measuring sand used in the mixing of mortars. Each kind of sand, previously well dried so that a sample taken from it lost no weight when heated to 100 deg. C., was mixed with progressingly increasing percentages of water. After each new addition of water, the moistened sand was mixed to perfect homogeneity, and the weight of 50 liters determined. There was then calculated the weight of one cubic meter of sand as measured under the conditions prevalent in the field, as well as the weight of dry sand contained in a cubic meter of moist sand. The weights found were as in Table I.

"It is apparent that a very small percentage of water suffices to lower enormously the weight of dry sand contained in a cubic meter. Thus with 2 per cent of water, this weight is about 20 per cent less than the weight of the same sand measured dry. As the percentage of moisture is increased, this weight tends to become constant, increasing but slightly."

"Table II, deduced from the same figures, shows how the richness of mortars may differ, varying, with the percentage of water contained by the sand."

From Feret's data obtained more than a quarter of a century ago, it is evident that mortar and concrete mixtures, in which the sand and gravel are volumetrically measured in the moist condition, will be richer in cement than similar mixtures measured in the dry state.

I would be much obliged to you for publishing this comment in your columns, if for no other reason than that of bringing before the readers of *Engineering New-Record* the much neglected but masterly work of Feret on concrete aggregates and mortars. Much information that has appeared in the recent scientific press in the light of original discoveries will be found lucidly expounded in his paper.

Yours truly,

ALFRED E. W. KING,
Chemist and Testing Engineer,
Bureau of Science.

Manila, P. I.,
Sept. 2, 1920.

TABLE II.

Dune Sand	Mixture weight (Weight of cubic meter dry sand)	Mixtures Actually Obtained by Using Moist Sand Instead of Dry Sand					Weight of Cement Required by One Cubic Meter of Moist Sand, to Obtain Mixtures Sought				
Quantity of water used to moisten 100 kg dry sand	0	0.5 kg.	1 kg.	2 kgs.	3 kgs.	5 to 10 kgs.	0.5 kg.	1 kg.	2 kgs.	3 kgs.	5 to 10 kgs.
	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.
	200	224	238	245	249	254	179	168	163	161	158
	300	335	357	368	373	381	269	253	244	241	236
	400	446	486	490	497	508	359	336	326	321	315
	500	559	595	612	621	634	448	421	408	402	394
	600	670	714	735	745	761	538	505	489	482	473
	800	895	951	980	995	1,015	716	671	652	643	630
	1,000	1,119	1,190	1,226	1,242	1,270	895	840	816	804	788
	1,500	1,676	1,784	1,839	1,864	1,902	1,342	1,261	1,223	1,208	1,183

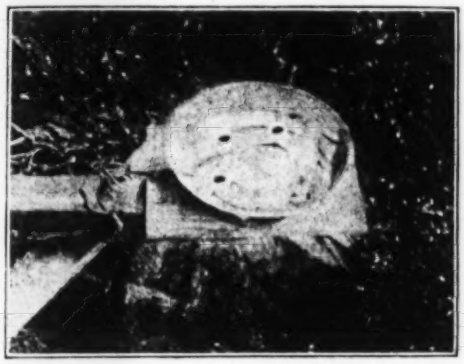
[While the title to the note referred to is possibly misleading, the main criticism in Mr. King's letter is due to a confusion in expression. Feret's tests confirm the Bureau of Standard statement that more cement is required (i.e., used under the usual system of proportioning in a given volumetric mix when the aggregate is wet than when it is dry and that, therefore, the concrete is stronger than it is intended to be. If the exact bulking effect of the wet sand was known in each case and the amount of cement varied accordingly, there would be no difficulty.

Mr. King is correct in stating that too little credit is given M. Feret for the remarkable investigations he carried on 20 years before the rest of the profession began to appreciate their importance.—Editor.]

HINTS FOR THE CONTRACTOR

Milk Pan for Reflector for Flood Light

ON THE Caribou development of the Great Western Power Co., on the Feather River in California, ordinary milk pans are used with great success as reflectors for flood lights throughout the work. One of these pans mounted on a standard is shown in the accompanying view. It is of bright new tinplate and carries six bulb sockets with lamps of varying intensity according to the needs of the work. The results are reported to be eminently satisfactory.



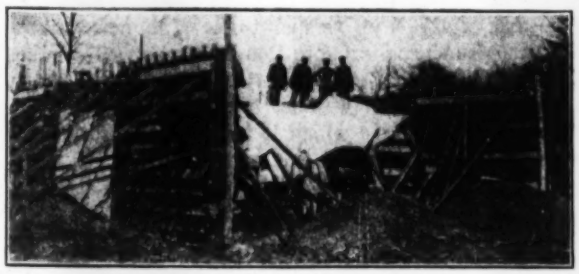
MILK PAN REFLECTOR FOR FLOOD LIGHT

Large Concrete Box Culvert Poured at Below Freezing Temperature

By S. W. Aldrich
Resident Engineer, Illinois Division of Highways

IN the construction of a section of Federal-Aid Project 14, Fayette County, Illinois, installation of a number of large concrete box culverts was necessary. Inasmuch as the work was done during November and December, 1920, the method of protecting concreting during cold weather, herein described, is considered unique.

Board slats were nailed on to the 2 x 4 in. uprights



STRAW PACKING ENTIRELY SURROUNDS FORM

—the form supports—and the interior of this space was securely and tightly packed with dry straw. Culvert openings were closed up by heavy canvas sheets. The top of the box also was covered with canvas. Inside the box, three medium-sized oil stoves were kept heated continuously during pouring and for a period of five days after the culvert was poured.

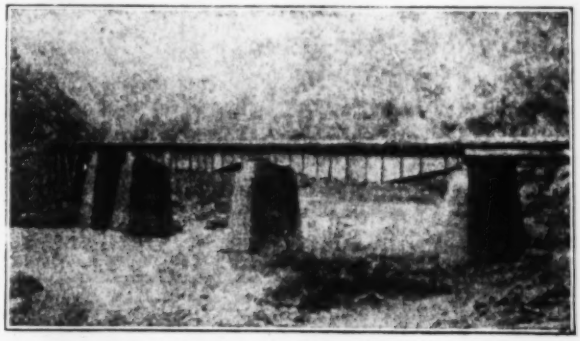
During the pouring and until the box was stripped, 6 days later, the lowest temperature was 22 deg. F. No heating of materials was necessary as the day temperature was from 5 to 10 deg. F. above freezing point. On stripping the forms a thorough inspection was made and no effects of frost were noticeable. The writer believes that this method of concrete protection is reliable to temperatures above 15 deg. F.

Five other boxes of approximately the same dimensions as the one here illustrated were constructed at the same time and under the same conditions. The results were similar in each case.

Hoolan Bros., of St. Louis, were the contractors, with R. J. Monahan as foreman in charge.

Old Turntable Girders Used for Bridge

IN THE construction railroad which leads from Howells, Cal., to the Caribou plant of the Great Western Power Co. several rivers are crossed. When the railroad was built it was very difficult to get steel for bridges. The construction engineers, however, in scouting around the country found an old railroad turntable which could be purchased. This was bought and the main girders installed as shown in the view for one of the bridges in two of the lines crossing. The railroad is standard gage and about ten miles in length up the Feather River valley.



TURNTABLE GIRDERS USED FOR BRIDGE

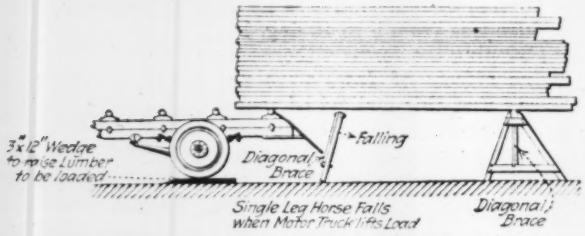
Simple Method Used To Load Lumber on Trucks

A FOUR-LEG lumber horse, a two-leg lumber horse and a 3 x 12-in. wedge are the only necessities for loading lumber upon motor trucks, according to a recent issue of *Lumber*. A description of the method used in loading lumber in this fashion is as follows:

A four-leg horse, built so as to sustain the heaviest lumber loading, is placed at any location accessible by motor truck and within range of the material to make up the delivery order. The horse so placed will then constitute the back support for the load of lumber. A special two-leg horse of strong heavy stock, well braced, is made of the same height as the back four-leg horse, both of these horses standing a little higher than the bed of an auto truck. The two-leg horse will constitute

the front support for the load of lumber. Lumber is piled upon these horses so that the front one is vertical, making the pile and its connection with the two braces rigid.

The motor truck is backed into the load, it being necessary for the back wheels to mount the wedge pieces which are so placed that the extreme back end


3"x12" Wedge to raise Lumber to be loaded
Diagonal Brace
Falling
Single Leg Horse Falls when Motor Truck lifts Load
Diagonal Brace

TRUCK BACKING UNDER LOAD, RELEASES FRONT SUPPORT

of the truck is well under the load before the wheels mount them. In mounting the wedges, therefore, the truck will lift the entire load, pivoting it on the rear support. With the load thus elevated the two-leg horse is released. The truck can then be backed under the entire load.

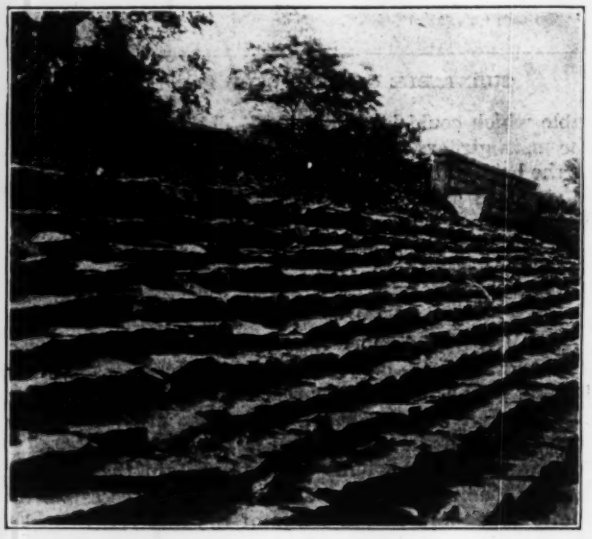
This method of operation, however, can only be used to advantage in the case of auto trucks whose beds are fitted with rollers.

Stepped Rip Rap of Large Stone Retains Highway Fill

By F. W. Epps

Bridge Engineer, Kansas Highway Commission

THE accompanying photograph shows a system of using rip rap which was employed on a 2 : 1 fill on a Federal-aid hard-surfaced project in Bourbon County, Kansas. A large amount of fairly uniformly



RIP RAP LAID UP IN STEPS ON KANSAS ROAD

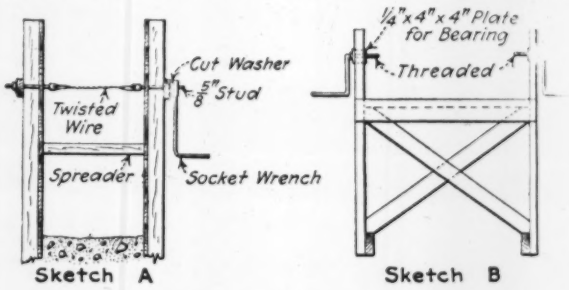
sized rock about 8 in. in thickness was available near the site. It was decided to lay the rip rap in steps, a system which proved to be very satisfactory, as it gives a good appearance and fairly uniform slope.

Job-Fabricated Wire Ties for Wall Forms

By Donald G. Coombs

Office Engineer, Braden Copper Co., Rancagua, Chile

WIRE ties, with malleable iron socketed heads, were used for wall forms on the Lake Keechelus dam with an advantage over both the ordinary tie wired to the studs and the bolt tie, with a pipe spacer. Sketch A indicates the method of applying the tie to the form. These ties, wire and heads, complete to length, were cheaply fabricated with the device shown by sketch B.



METHOD OF FABRICATING AND APPLYING WIRE TIES FOR WALL FORMS

As shown dotted on the sketch, the heads are threaded onto the projecting ends of the handles, the tie wire is threaded through the holes in the ends of the heads, and the handles are turned in opposite directions until the wire is sufficiently taut. Two laborers with this rig were able to make enough ties for the entire job in less than three days.

New Process for Rapid Kiln-Drying

DEVELOPMENT of a new kiln-drying process for lumber, which makes use of superheated steam, is announced by the Forest Products Laboratory, Maadison, Wis. The process is capable of drying 1-in. softwood lumber green from the saw to 10 per cent moisture in 24 hours. It consists in forcing superheated steam at high velocity through the pile of lumber in the kiln first in one direction and then in the opposite, and accomplishes verp uniform drying with a minimum of checking and warping. The process is more costly in fuel than present processes, and is not considered to be adapted to lumber more than 2 or 2½ in. thick, on account of the danger of injury to the wood from excessive length of exposure to the high temperature. The new process has been found applicable to Douglas fir as well as other firs, Western (but not Eastern) hemlock, white cedar, sugar pine, and yellow pine, but there are some important soft woods to which it is entirely unsuited. It reduces the toughness of the wood slightly, and therefore should not be used for airplane or wagon stock.

Properly Constructed Jetties

Results obtained in securing the passage through the bar at the mouth of the Columbia River are a splendid example of what may be accomplished by properly constructed jetties. Before the jetties were put in the greatest difficulty was experienced in maintaining a depth of 20 ft. across the bar and that channel was irregular and shifting. Now a straight channel of 40 or more feet in depth and 3,000 ft. wide is maintained almost automatically.

NEWS OF THE WEEK

New York, January 20, 1921

G. S. Webster New President of Am. Soc. C. E.

Chief of Bureau of Surveys, Philadelphia, Has Served City Continuously for 46 Years

Forty-six years of continuous service in the engineering departments of the city of Philadelphia is the outstanding feature of the professional record of George S. Webster, who was elected president of the American Society of Civil Engineers at its annual meeting in New York City Jan. 19. Mr. Webster is best known for his work as chief of the Philadelphia Bureau of Surveys, in which capacity he has been the directing head of many large municipal projects, including sewerage and sewage treatment, bridges, city planning, dock and harbor improvements. Mr. Webster was born in Philadelphia in 1855 and was graduated from the University of Pennsylvania in 1875. He entered the city's engineering service as transitman immediately after leaving college and was assigned to work on gravity railroad surveys in Fairmount Park. Until 1876 he served as assistant engineer on surveys for buildings, grounds, railroads and drainage for the Philadelphia Centennial Exhibition, after which, for a few months, he became assistant on the U. S. Coast and Geodetic Survey of Eastern Pennsylvania. When the Lombard St. outlet sewer work was undertaken in 1876 Mr. Webster was appointed assistant in the Philadelphia Survey and Engineering Department, where he continued until 1880 on this project, in addition to the Wingshocking main sewer, and also prepared

(Continued on p. 141)

Newly Elected President of the American Society of Civil Engineers and Former Chief Engineer, Bureau of Surveys, Philadelphia

GEORGE S. WEBSTER

Civil Engineers Hold Annual Meeting

Factions Avoid Clash at Opening Session — Committee on External Relations Discontinued—New Constitution To Be Drafted and Sumbitted by Original Committee

A victory for the "progressive" group of the American Society of Civil Engineers was won at the annual meeting which opened yesterday at the Engineering Societies Building in New York City when George S. Webster, of Philadelphia, was elected president, with 4,036 votes in opposition to J. Waldo Smith, of New York, for whom 2,819 ballots were cast. The other candidates of the progressive group were also carried into office by substantial margins. A record vote of 7,008 ballots was polled in this year's annual election.

Before the result of the election was announced Gardner S. Williams, speaking for that group which terms itself "progressive" and is designated by its opponents as "radical" pledged wholehearted support for any program which the majority of the society, as shown by its vote for the election of officers, might decide upon. Mr. Williams' declaration came during the discussion of the proposed new constitution for the society and was received with great enthusiasm by an audience which filled the main auditorium and a large portion of the gallery in the 39th St. building. Contrary to predictions of a factional fight, the business meeting, after a period of parliamentary discussion which threatened to stifle constructive work, passed off smoothly, culminating in the announcement of the election to the presidency of Mr. Webster. With President Arthur P. Davis in the chair the meeting opened with the annual report of the Board of Direction, which will be summarized in next week's issue of this journal. The election of the following members of the nominating committee, to serve during the ensuing year was announced, the number preceding each name being that of the district represented: (1) W. T. Chevalier; (3) A. L. Johnson; (5) J. H. Van Wagenen; (6) George H. Tinker; (10) F. E. Weymouth; (11) J. H. Brillhart; (13) T. H. Means:

Speaking for the committee on the bearing value of soils, R. A. Cummings, chairman, presented a digest of six

appendices which represented the year's work. The first of these related to definitions of soils, the second to their mineral composition, the third to the relation of color and its importance, the fourth to factors in soil classification, including the influence of capillary water, water content, texture and size of grain, influence of colloid clay and porosity; while the fifth dealt with definitions of settlement, allowable loads, etc., and the sixth with the laboratory apparatus developed by the committee during the year. In the latter connection, Mr. Cummings spoke of a high speed centrifuge by which it was possible to secure a precipitation of microscopic particles of colloidal clay not hitherto found feasible. The report was accepted and the committee continued in existence.

Stresses in Railway Track

For the committee on stresses in railway track, Prof. A. N. Talbot supplemented the elaborate report submitted last year by a statement of progress, in which it appears that tests have been conducted to demonstrate the effect of curves on track stresses on the Illinois Central, the Delaware, Lackawanna & Western, and the Atchison, Topeka & Santa Fe. The committee also studied the effects on track of flat spots in wheels. The report was accepted and the committee continued.

For the committee on highway engineering, H. Eltinge Breed presented a review of federal-aid work, dealing with the original federal-aid bill passed in 1917 and with the later Townsend bill providing for a national highway system and the creation of a federal highway commission. Two amendments to the national highway bill are needed, he said, the first authorizing an increase over the amount of $20,000 per mile for federal-aid roads and the second a larger appropriation for roads passing thorugh public lands. The committee's report was received and the committee continued.

A progress report, only, was submitted for the committee on bridge design and construction, H. B. Seaman, chairman, stating that one meeting had been held but that work had not yet progressed sufficiently to warrant a detailed report. The committee was continued.

No report was received from the committee on the Alfred Noble memorial. This committee also was continued.

External Relations

Speaking for the Board of Direction, Leonard Metcalf, of Boston, presented a digest of the reports on external relations prepared by a committee of corporate members and reviewed by a committee of past-presidents. The committee of corporate members recommended that the best interests of the society demanded the appointment of an aggressive committee to initiate and consummate through the Board of Direction all matters connected with external relations and to co-operate actively with other allied technical organizations. Such a committee, it was advocated, should be composed fo corporate members of whom one should be a member of the Board of Direction, two from District 1, and one from each of the other districts, appointed by hte Board of Direction and acting with the advice of the membership of each district.

The committee of past-presidents which reviewed the foregoing report, however, concluded that it was not desirable to appoint a continuing committee on external relations and advocated that the Bard of Direction keep in touch with the activities of the Federated American Engineering Societies and cooperate with this and other national organizations with the aim of promoting harmony on questions in which the profession may be of service.

The past president's committee favored the establishment and encouragement of local sections under rules adopted by the Board of Direction.

Acting upon these two reports the Board of Direction, at a meeting Jan. 17, passed a resolution suggesting to the incoming board that matters of external relations be handled by the Board of Direction sitting as a committee of the whole and that local committees be named to work with the board member in their districts, with a view to securing co-ordinated action.

Amendment of Constitution

A report of the committee on amendments to the constitution was presented by Col. Peter Junkersfeld, in which it was recommended that the various suggested amendments on which action is now pending be not adopted, in view of the fact that the committee has practically completed an all-inclusive study and revision of the existing constitution and has had printed a draft of a new document to replace the existing constitution and by-laws.

A long parliamentary squabble on the propriety of discussing the proposed amendments to the constitution, in view of the fact that Col. Junkersfeld's committee had prepared a complete new document which will be presented at the next annual convention, followed the presentation of the committee's report. Under the present constitution a number of proposed amendments to the constitution must go out to the society in the form of letter ballot. George W. Fuller recommended that this letter ballot be sent out with the recommendation that all amendments be defeated, thus clearing the way for the committee's report. It was at this point that Gardner S. Williams made the declaration that the division of the society with which he had been associated—the "radical element," as the opposition called it—would accept the decision of the majority of the membership, as indicated by the election, and work in harmony with the new administration.

The upshot of the discussion was the passage of a resolution, offered by Mr. Fuller, continuing the committee on the revision of the constitution so that it may present its report in time for the next annual convention. Proposals to discuss pending amendments were defeated, as was also a resolution seeking to change the composition of the existing committee by requiring in its membership representation from each of the thirteen districts of the society. It was pointed out by Allen Hazen, Col. F. A. Molitor and others that an attempt now to alter the committee or interfere with its work would result in the utmost confusion.

Wellington Memorial

It was announced that the Board of Direction had accepted the offer of *Engineering News-Record* to contribute $2,000 for the establishment of a memorial to Arthur M. Wellington, an award to be made annually for the best paper submitted, either by a member or non-member of the society, on any subject relating to Transportation, either on land, water, or in the air.

Prizes

The committee on prizes announced the following awards for papers published by the society from January, 1918, to May, 1920, inclusive: Norman medal to J. A. L. Waddell, for paper "The Economics of Steel Arch Bridges"; J. J. R. Croes medal to B. A. Smith, for paper "Arched Dams"; Thomas F. Rowland prize to Charles E. Fowler, for paper "Revision of the Niagara Railway Arch Bridge"; the James Laurie prize to Dabney H. Maury, for paper "Water Supply for the Camps of the United States Army"; Collingwood prize for juniors to Floyd A. Nagler, for paper "Verification of the Bazin Weir Formula by Hydro-Chemical Gagings."

Results of Election

The election of officers, in which a record total of 7,008 votes were polled, resulted as follows:

President—George S. Webster, of Philadelphia, who received 4,036 votes as against 2,819 for J. Waldo Smith.

Vice-presidents—E. E. Wall, St. Louis (4,003), and Andrew M. Hunt, New York (3,947), who defeated Allen Hazen, New York (2,947), and Frank G. Jonah, St. Louis (2,971).

Treasurer—Otis E. Hovey, New York (4,093), who defeated Arthur S. Tuttle, New York (2,793).

Directors—District 1, John P. Hogan, New York (6,643), and Ira W. McConnell, New York (4,052), who defeated Robert S. Parsons, New York (2,740). District 4, Richard L. Humphrey, Philadelphia (4,001), who defeated Harry A. Lane, Baltimore (2,449). District 9, Baxter L. Brown, St. Louis (3,883), who defeated Alexander Maitland, Jr., Kansas City (2,609). District 10, Frank T. Darrow, Lincoln, Neb. (6,689). District 11, George G. Anderson, Los Angeles (4,046), who defeated Richard D. Parker, Austin, Tex. (2,538).

George S. Webster

(Continued from p. 139)

plans and strain sheets for arches of various sizes and assisted on a variety of large municipal engineering works.

After a brief period as cement inspector Mr. Webster was appointed, in 1880, as a member of the Philadelphia Board of Surveyors and as surveyor and regulator of the tenth Philadelphia survey district, comprising about one-third of the total territory of the city. In this capacity he served until February, 1892, in direct charge of all surveys of property and municipal engineering work. He prepared city plans of street lines and grades for that large territory and provided for a system of drainage and avoidance of all railroad grade crossing. One of his principal tasks was the direction of the design of 50 miles of sewers, in addition to surveys for bridge and highway improvement work in Philadelphia.

HEADS BUREAU OF SURVEYS

Mr. Webster's familiarity, through many years of service, with Philadelphia's municipal problems led, in 1892, to his appointment as principal assistant engineer in the Bureau of Surveys, and he was quickly advanced in this organization to the post of acting chief engineer, which he assumed in 1892. The following year he was given the title of chief engineer, Bureau of Surveys, and upon him was placed the responsibility of all bridge designs and construction, sewerage design and works, and surveys of every description. As president of the Philadelphia Board of Surveys he was in full charge of the city plan and was also ex officio member of the Board of Harbor Commissioners and the Fairmount Park Commission.

Design and construction of many large bridges have been a feature of Mr. Webster's work. Among the most notable are the concrete arch bridge over Wissahickon Creek, the Falls, Gray's Ferry and the Passyunk Ave. bridges over the Schuylkill River.

As the city's representative Mr. Webster has supervised the elimination of many grade crossings in Philadelphia, the most important being the New York division of the Pennsylvania R.R., Philadelphia & Reading Ry. on Ninth St. and Pennsylvania Ave., the Richmond branch of the Philadelphia & Reading, Philadelphia & Trenton R.R. on Trenton Ave., and other important work in South Philadelphia. The widening of Delaware Ave. also was instrusted to him, in addition to the erection of large municipal piers and the dredging of the channel of the Delaware River.

Mr. Webster's most recent work has been as a member of the Delaware River Bridge Joint Commission.

He was elected an associate member of the American Society of Civil Engineers Sept. 7, 1892, a director in 1904, and vice-president in 1917.

Plan Irrigation System on San Joaquin River

New California Project Will Have Dam 325 Ft. High, 4,200 Ft. Long and 1,400,000 Cu.Yd. Volume

Plans are about complete for the construction of the Madera irrigation project on the San Joaquin River near Fresno, Cal., one of the largest private irrigation projects ever undertaken. The project will comprise 350,000 acres and will cost about $28,000,000. A vote is about to be taken in the district for the issue of the bonds and the prospect for the construction is good.

The San Joaquin River is the main source of the water supply, but there will be diversion from Fresno River, Chowchila River, Merced River and about 150,000 acre feet pumped from underground sources. The main storage will be near Friant, Cal., on the San Joaquin River, where a reservoir of 450,000 acre-ft. will be provided by a gravity masonry dam 4,200 ft. long, 325 ft. above bedrock, and storing 285-ft. head of water. From this dam there will be a high level irrigation canal served from the reservoir and two power plants, of total capacity of 65,000 kw. One plant will utilize the power from water delivered downstream under an average head of 200 ft. The other will utilize the water delivered to the upper canal from the reservoir under a 115-ft. head. These plants will provide 200,000,000 kw. hrs. per year average.

The dam itself will contain 1,400,000 cu.yd. of concrete and will have a spillway consisting of sixty-five 5 x 10-ft. siphons, supplemented by 100 ft. of gate to take care of dirt. These spillways will provide for the passage of 100,000 sec. ft. It is intended to build the dam with sand-cement, using a fifty-fifty mixture to be ground at the site. The engineers are testing now various mixtures, but it is thought that the even mixture will be used. A special concreting plant must be provided because it is necessary to lay 400,000 cu.yd. of concrete per year; that is an average of 1,200 yd. per day. In order to take care of contingencies a plant providing a sure capacity of 2,500 yd. per day is to be built. It is intended to lay the concrete from a railway spanning the dam site which will be supported on steel trestle built into the dam structure. As the dam rises the cross braces and horizontal members of the trestles can be removed, but the posts will remain in the concrete. Vertical openings will be left in the concrete as the dam rises and will serve not only as bypasses for the river during construction but also as final contraction joints. It is expected that the work will be started inside of a year and will take four years to finish. The estimated cost of putting the water on the ground is $80 per acre.

F. M. Carter is chief engineer, Thos. H. Mean of Cope, Rand & Means, San Francisco, is consulting engineer on land and canal system, and Quinton, Code & Hill of Los Angeles are consulting engineers having charge of the design and construction of the dam and power plants.

New Standardization Work

Standardization of terminal marking for electrical apparatus has been initiated under the jurisdiction of the American Engineering Standards Committee. The Electric Power Club has been designated as sponsor. The work grew out of a proposal made at the Brussels meeting of the International Electrotechnical Commission in March, 1920, when a standard method of marking transformer terminals was asked for, but broader standardization was then approved and delegated to the Americans. The result of the work conducted under the sponsorship is to be presented at the next meeting of the international commission.

Requests from the electrical industry for standards of rating electrical machinery have led to the formation of a committee under the sponsorship of the American Institute of Electrical Engineers. This work also originates from proposals made at the Brussels congresss. The committee will contain official representatives of the Electric Power Club, the National Electric Light Association and various other interested bodies.

In the field of zinc a number of questions pertaining to grading, thicknesses of sheets, methods of sampling and analyzing ores and finished material, and the like are to be dealt with by a standardizing committee working under the sponsorship of the American Society for Testing Materials and the American Zinc Institute.

Suggests State Board to Control Intercounty Bridges

Difficulties between Essex and Morris counties, New Jersey, over the question of whether several bridges crossing the Passaic River on the dividing line between the two counties shall be repaired or rebuilt, have led County Engineer F. A. Reimer (Essex) in his report to the freeholders to propose that control of intercounty bridges be placed by law in the hands of a state board.

The dispute in question, in which Essex County holds that the bridges should be rebuilt, while Morris County considers it sufficient that they be repaired, resulted in the former county closing the roads leading to the bridges, but nearby residents later destroyed the barricades. A commission, appointed by the Supreme Court, is now considering the situation with a view to deciding on reinforcement or reconstruction, as provided for by the present laws. Since the report of such a commission is not mandatory on the counties, however, Mr. Reimer proposes that a state bridge board be created to take charge of jointly controlled bridges throughout the state.

Begin Foundation Borings for Philadelphia Bridge

Contract for borings at the sites proposed for the Philadelphia-Camden bridge has been awarded to Ridpath & Potter, Philadelphia, and work began on Jan. 6. The contract covers 1,260 ft. of casing sunk to ledge rock and 160 ft. of core boring to prove the rock. Six bids for the work had been received, from H. F. Dougherty, Wilmington; J. B. Rulon, Philadelphia; Artesian Well Drilling, Philadelphia; Ridpath & Potter Co., Philadelphia; Sprague & Henwood, Inc., Scranton, and T. F. Edwards, Jersey City. The totals range from $4,367 to $11,990. For sinking casing the unit price bid ranged from $1.95 to $5 for work on land and from $2.45 to $12 for work in the river. For core boring the prices ranged from $4.20 to $5 for work on land and from $6 to $16 for work in the river.

A three-day traffic census was conducted by the Board of Engineers during the Christmas holidays with the assistance of University of Pennsylvania students. Count was taken on three days of all vehicles using the ferries, and origin, destination, route, etc., recorded. The results will be considered in determining on questions of the approaches, but future traffic development rather than present traffic is likely to have a determining weight.

Paul P. Cret, Philadelphia, has been appointed architect to the Board of Engineers, and E. B. Bergenthal, Chicago, chief draftsman.

Nominate Officers for A. R. E. A.

The nominating committee of the American Railway Engineering Association has selected the following candidates for 1921. President, L. A. Downs, vice-president and general manager, Central of Georgia Ry., vice-president, E. H. Lee, vice-president and general manager, Chicago & Western Indiana R. R.,; secretary, E. H. Fritch; treasurer, G. H. Bremner. A list of nine names is also reported from which to select three directors. The election will occur at the annual meeting in Chicago on March 15-17.

St. Louis Societies Affiliate

The Associated Engineering Societies of St. Louis, modeled along the lines of the Federated American Engineering Societies, was brought into being and given permanent form at the first meeting of the joint council, composed of two delegates from each of the member societies, held at the Engineers' Club of St. Louis Jan. 5. H. W. Eales, who is president of the Engineers' Club of St. Louis, was elected president of the new organization, and W. W. Horner, chief engineer, sewers and paving, of St. Louis, was elected vice-president. The members of the new association are the Engineers' Club of St. Louis and the local sections of the A.S.C.E., A.S.M.E., A.I.E.E. A.I.M.M.E., and A.S.R.E.

Minnesota License Bill Introduced

A registration law for architects, engineers and land surveyors has been introduced into the Minnesota Legislature. It follows closely the model law of Engineering Council and was prepared by the legislative committee of the Minnesota committee of the Minnesota Joint Engineering Board. The bill was recently revised to meet the objections of several socieites, as mentioned in *Engneering New-Record* Nov. 11, 1920. Copies may be obtained from the secretary of the Board, 811 Guardian Life Bldg., St. Paul.

New York Section Am. Soc. C. E. Meeting Date Advanced

In order to avoid a conflict with the annual meeting of the American Institute of Electrical Engineers and the American Institute of Mining & Metallurgical Engineers the February meeting of the New York Section of the American Society of Civil Engineers has been postponed from Feb. 16 to Feb. 23. The subject of the meeting is "Light, Heat and Power." The principal paper will be by Colonel William Barclay Parsons. Representatives of the local sections of the mechanical, electrical and mining societies have been invited to attend and send delegates to discuss Colonel Parsons's paper which will apply to the problem of the New York metropolitan district.

Road Congress Prize To Be Awarded in 1922

The sum of 4,500 francs is available for distribution as prizes during the 1922 meeting of the Permanent International Association of Road Congresses. The money will be awarded either in a single prize or may within the discretion of the jury be divided among a number of contestants submitting the best discussions having in view the encouragement of progress in the construction, maintenance and administration of roads, and the improvement of traffic.

The first award of this prize was made during the Third International Congress in London in 1913. The prize usually is 1,500 francs. Inasmuch as no awards were possible either in 1916 or 1919 there are now 4,500 francs which may be awarded.

Authors of papers must have been members of the Permanent International Association of Road Congresses since Jan. 1, 1919. Members of the Permanent International Commission will not be allowed to compete. The competing papers should reach, post free, the secretary-general of the association before Nov. 1, 1921. The prize papers will be published during the year the competition is held, under the auspices of the association and at its expense.

Additional information regarding the competition may be secured from the secretary-general of the association, whose address is 1, Avenue d'Iéna, Paris.

Syracuse Takes State Canal Lands for Grade Crossing Elimination

Work on clearing titles to the Erie Canal lands in New York has been started. This is the first actual development in the taking over from the state by the city of lands to be used in the prospective grade crossing eliminations of the railroads running through Syracuse.

New Jersey Highway Requirements

In his recent annual message to the New Jersey Legislature Governor Edwards stated that $55,000,000 is needed to complete the present proposed state highway system in New Jersey, bringing the total cost up to $73,000,000, the sum of $18,000,000 having already been spent.

Gulf Coast Bridges Ordered Rebuilt

In a decision just rendered by the Louisiana Railroad Commission on complaint that the bridges of the Louisville & Nashville R.R. over Chef Menteur and Rigolets Pass on the Gulf Coast southeast of Lake Borgne are unsafe, the commission decides that the bridges are safe, "possessing sufficient strength to withstand almost any weather disturbance, except, of course, the violent tropical hurricanes which in the past have appeared at periods about five or six years apart." However, in order to hasten the replacement of the bridges by permanent structures as planned by the railroad for some years past the decision orders the company to begin construction of new bridges by July 1, 1921.

Housing Problems to Come Before Washington Conference

A conference on the national housing problem will be held at Washington, D. C., Jan. 27 and 28 under the auspices of the Chamber of Commerce of the United States. There will be discussions by representatives of various business industries, members of Congress and government executives, housing specialists and others. The national chamber announces that "representatives of 100 or more chambers of commerce through the country that have organized housing corporations will give the conference the benefit of their experiences." Among the topics announced for discussion are the housing problem in relation to the welfare of the American people, to construction industries, to employers, to standards of living and to the immigrant. Questions of legislation, taxation, co-operation or mutual financing of housing developments, labor, available supplies of building materials and future price movements will be taken up. One of the special subjects for presentation is "Effect of the New York Building Investigation Upon Costs of Construction."

Fail to Agree on Uniform Vehicle Law

National Conference on Highway Traffic Regulations Approves General Principles Only

Delegates representing thirty national and regional organizations at the National Conference on Highway Traffic Regulations held in Washington, D. C., Jan. 10-12, failed to agree on a specific form of uniform vehicle law presented by a drafting commitee, the net result of the meeting being the endorsement of a declaration on "general principles" which were a practical duplication, in general phrases, of the specific language of the uniform law prepared last year by the Joint Committee on Uniform Vehicle Laws, of which H. G. Shirley was chairman.

Such diversified interests as state highway departments, agricultural implement associations, automobile organizations, insurance companies, electric railways, police departments, and trailer manufacturers were represented at the conference. At one time it appeared that the meeting might end abruptly when the charge was made that the conference was merely an attempt to appropriate the uniform vehicle legislation work done last year by the joint committee representing the American Association of State Highway Officials, National Automobile Chamber of Commerce, American Automobile Association, and the Highway Industries Association. The model bill prepared by the Washington conference's drafting committee was discussed and was then quietly interred when a deadlock was avoided by the expedient of endorsing a set of "general principles."

The following temporary officers were named at the opening session: Chairman, C. M. Talbert, director of streets and sewers, St. Louis; secretary, D. R. Faries, general counsel, Automobile Club of Southern California, Los Angeles; assistant secretary, S. J. Williams, National Safety Council, Chicago.

Discussion of Uniform Law

A drafting committee, consisting of Mr. Faries, chairman; David Van Schaack, representing the National Workmen's Compensation Service Bureau; W. H. Maltbie, American Electric Railway Association; and Harry Meixell, Jr., National Automobile Chamber of Commerce, met in Washington prior to the conference and prepared the uniform law that was printed and submitted to the conference for disscussion at its opening session.

While the uniform act was submitted as a piece of state legislation a defect in it, according to Henry G. Shirley, of the Federal Highway Council, lay in its neglect of municipal traffic problems. He suggested that a proper law should consist of two parts, the first dealing with state matters and the second with city traffic regulation, the latter part to be worded in very general terms so as to meet the conditions in cities of different sizes.

It soon developed in the discussion that there could be little hope of reconciling the interests of the state highway officials, the automobile and truck associations, and the agricultural implement organizations in the approval of a specific bill. The farm implement delegates demanded either a separate law relating entirely to agricultural machinery or a separate section in any proposed uniform law which should deal specifically with this class of equipment.

Highway Engineers Object

A strong objection to the use of cleated farm tractors on highways was voiced by John N. Mackall, chairman of the State Roads Commission of Maryland and representing the American Association of State Highway Officials, who classified them as one of the greatest menaces to public roads.

Discussion of the reciprocity feature of the proposed act brought out an objection by Mr. Mackall to the proposed period of 90 days for motor trucks. While satisfactory for passenger cars, the 90-day allowance for trucks he believed should be revised to a basis of one round trip per week.

An amendment proposed by Messrs. Mackall, Upham and Monroe, representing the state highway departments respectively of Maryland, Delaware and West Virginia, suggested reducing the maximum weight of vehicles as proposed by the drafting committee from 28,000 to 20,000 lb. for four-wheeled vehicles and from 40,000 lb. to 30,000 lb. for six-wheeled vehicles. They advocated reducing the permissible weight per inch width of tire from 800 to 650 lb.

Mr. Mackall cited the case of Maryland, which had been called upon to expend $600,000 in the repair and rebuilding of its 1,700-mile system of state highways damaged during the last few years by heavily loaded motor vehicles. Maryland restricts the gross weight to 20,000 lb. per vehicle, and under these conditions Mr. Mackall finds that the roads can be adequately maintained.

Future Activities

The committee on future activities, consisting of C. E. More, David Van Schaack, David R. Faries, George C. Diehl, H. G. Shirley, H. W. Perry, and John Rynerson, recommended: (1) That the conference adopt only general principles for a uniform vehicle law; (2) that no final vote on the proposed law be taken; and (3) that it would be unwise to set up any new organization to continue the work of the conference and that the conference should adjourn without provision for future meetings.

Harry Meixell, Jr., representing the National Automobile Chamber of Commerce, threw a verbal bombshell into the meeting by declaring that its efforts were a duplication of those begun by a group of other organizations three years ago and which had been crystallized in the publication and distribution by the Federal Highway Council of a proposed uniform vehicle law of which between 30,000 and 40,000 copies had been distributed. (The main features of the proposed law referred to are given on p. 112). Mr. Meixell charged that a group from California in calling the conference had endeavored to seize upon the work of the Motor Vehicle Conference Committee, formed last year, and appropriate it as their own. He asserted also that if another uniform vehicle law should be issued now it would create in state legislatures the utmost confusion.

The "general principles" which were endorsed by the conference are not here reproduced, inasmuch as they deal only in generalities and are, as a matter of fact, covered in specific terms in the proposed uniform law of the joint committee prepared last year by representatives of the state highway and motor vehicle interests.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; seventh annual convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN CONCRETE INSTITUTE, Detroit; Chicago, Feb. 14-16.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; New Orleans, Feb. 9-12.

The New York Post, Society of American Military Engineers, will hold its annual meeting and election of officers in New York City, Jan. 26 at Keen's Chop House, where a beefsteak dinner is scheduled for 7:30 p.m.

The Kentucky Engineers Club was organized Dec. 20 with the following officers: president, C. W. Lovelle; vice-president, V. P. Ligon; secretary, W. M. Jarvis; Treasurer, W. O. Snyder.

The Kentucky Highway Contractors Association, at a recent organization meeting elected George N. Eady, president; Henry Bickel, first vice-president; and George Carey, second vice-president.

The Illinois Section, Am. Soc. C. E., Jan. 13, elected C. B. Burdick, president for the ensuing year. J. N. Hatch was elected vice-president for two years. A. J. Hammond, vice-president, and W. D. Cerber, secretary-treasurer,

still have one year to serve. A. S. Baldwin, a member of the national committee on constitution, spoke on the work of the committee, no part of which has yet been finally decided upon. The request of the Texas Section for favorable action looking toward the defeat of bill in Congress (H.R. 12,466) authorizing utilization of the Yellowstone Park for water storage was considered the province of the parent society. In accordance with that principle the board of directors was asked to take up with the American Institute of Architects the question of uniform specifications for building in an effort to reduce the high cost of building construction.

PERSONAL NOTES

A. H. DIMOCK, city engineer of Seattle, has been reappointed by Mayor Hugh M. Caldwell for a three-year term. The salary of the position has been increased from $5,000 to $7,500.

HENRY W. BLAKE, editor of the *Electric Railway Journal*, was the guest of honor at a dinner given Jan. 6 by his associates in the McGraw-Hill Co. in recognition of his 30 years of service on the editorial staff of that publication.

JOHN P. LEO, chairman of the Board of Standards and Appeals, has been appointed commissioner of street cleaning, New York City, to succeed Arnold B. MacStay.

GEORGE S. WITTERS, formerly lieutenant, Engineers, U. S. A., has been appointed engineer of Ida County, Iowa.

PROF. F. E. GIESECKE, head of the engineering division of the bureau of economic geology and technology, University of Texas, has been appointed chairman of the problem committee, Federal Highway Council, Washington, D. C.

D. O. LEWIS, civil engineer, Victoria, B. C., has been elected president of the Association of Professional Engineers of British Columbia.

M. E. HIET, formerly engineer for Pawnee County, Oklahoma, has been appointed engineer of Nowata County, in charge of road construction.

DUDLEY P. BABCOCK, formerly assistant engineer, New York State Highway Commission, is now assistant engineer, Bronx Parkway Commission, Bronxville, N. Y.

JESSE A. JACKSON has been appointed engineer of the Seattle City Zoning Commission and is developing a plan for laying off the city in zones. Mr. Jackson has been in the employ of the engineering department of Seattle since 1902, except for the time spent in military service. He commanded the 116th field signal battalion of the A. E. F. in France, returning to Seattle in April, 1919, to resume the position of chief draftsman in the Seattle engineering department.

GANNETT, SEELYE & FLEMING, engineers, have been retained to make a report and recommendations on new sources of water supply at Greenville, Tenn., Eureka Springs, Ark., and Rouzerville, Pa.

C. C. BOYER, formerly with the California Highway Department, has been appointed district engineer, Nevada Highway Department, with headquarters at Las Vegas.

HORTON, BARKER & WHEELER is the name of a firm recently organized to continue the consulting engineering practice formerly carried on under the names of Robert E. Horton, consulting hydraulic engineer, Albany, N. Y., and Harry Barker & Robert C. Wheeler, engineers, New York. The firm will have headquarters at Albany, with offices in New York and Harrisburg, Pa., and an engineering laboratory at Voorheesville, N. Y. It will specialize in power development and transmission, water supply, sewerage and sewage disposal, public utility rates and valuations.

LOUIS S. LEVIN, formerly engineer of Allegan County, Mich., has been appointed roads engineer for Chippewa County.

W. A. HENDRY of Halifax, N. S., has been appointed chief engineer to the Provincial Highways Board of Nova Scotia. He has had long experience as a railway construction engineer in the Maritime Provinces and Newfoundland.

C. R. WRIGHT, formerly engineer for the ports of Toledo and Newport, in charge of harbor improvement work on Yaquina Bay, Ore., is now assistant engineer for the Port of Grays Harbor at Aberdeen, Wash., in charge of all harbor improvement work under the direction of C. A. Strong, consulting engineer, of Tacoma, Wash.

J. W. HOLMAN has resigned as superintendent of the Culbertson Construction Co., Youngstown, Ohio, to form the J. W. Holman Co., with office at Youngstown. The new company will engage in contracting, particularly railroad construction.

RUSSELL S. WISE has been appointed city engineer of Clifton, N. Y.

ROBERT MCFARLAND has been appointed superintendent of waterworks, Brandon, Manitoba, Canada.

CHARLES B. HAWLEY, formerly assistant hydraulic engineer, Aluminum Co. of America, has entered private engineering practice with offices in Washington, D. C.

ARTHUR H. BLANCHARD, consulting highway and transport engineer, Ann Arbor, Mich., has been retained by the city of Colorado Springs in connection with its $1,200,000 paving program.

W. D. JOHNSTON, who has been connected with the Iowa State Highway Commissison for nine months, has been appointed engineer of Black Hawk County, Iowa. Mr. Johnston was formerly city engineer of Waterloo.

OBITUARY

HARRY L. MARSH, vice-president Thompson-Starrett Co., New York, died Jan. 13 at Summit, N. J. He was born at Ithaca, N. Y. in 1875 and had been a resident of Summit since 1912. His early work was as civil engineer with the Chicago & Northwestern Ry. The principal projects under his direction during his term of office as an executive of the Thompson-Starrett Co. were the Woolworth Building, Hotel McAlpin and the Municipal Building in New York City and the Hotel Ambassador in Atlantic City, N. J. He was elected vice-president of the Thompson-Starrett Co. in 1915.

CHARLES E. SMITH, former secretary of the Master Builders' Exchange, and later secretary of the National Association of Builders' Exchanges, died Jan. 1 at his home near Camden, N. J.

DAVID C. HUMPHREYS, dean of the School of Applied Science of Washington and Lee University, died Jan. 11 at Roanoke, Va. He was born at Chatham Hill, Va., in 1855. For about six years he was U. S. assistant engineer on improvements on the Missouri River. He became adjunct professor of applied mathematics at Washington and Lee University and in 1889 was elected professor of civil engineering. He became dean of the school of applied science in 1904. From 1895 to 1908 he was resident hydrographer, U. S. Geological Survey.

SAMUEL M. FOUST, city engineer, Connellsville, Pa., died Jan. 5. He was born in Saltlick township in 1846 and had been a resident of Connellsville since the age of 19, for the greater part of the time employed by this city.

BRADFORD D. PIERCE, for 14 years director of public works of Bridgeport, Conn., died Jan. 12. He was born in Providence, R. I., in 1842. As a young man he was associated with his father, M. R. Pierce, in the contracting business in New York on drainage and sewerage projects. In 1862 he founded the contracting firm of Pierce & Co. at Bridgeport. About twenty years ago he was appointed director of public works.

DR. HENRY A. BUMSTEAD, professor of physics and director of the Sloane Physical Laboratory at Yale University, and for the past half year on leave from the university as chairman of the National Research Council of Washington, D. C., died Dec. 31, while returning to Washington from Chicago, where he had been in attendance at the meetings of the American Association for the Advancement of Science and affiliated societies.